PROCEEDINGS

OF THE

LITERARY AND PHILOSOPHICAL SOCIETY

OF

LIVERPOOL, Eng. —

DURING THE

SIXTY-SECOND SESSION, 1872-73.

No. XXVII.

LONDON:
LONGMANS, GREEN, READER, & DYER.
LIVERPOOL:
DAVID MARPLES, LORD STREET.

1873.

1874. Feb. 17
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ORDINARY MEMBERS,

ON THE SOCIETY'S ROLL AT THE CLOSE OF THE 62ND SESSION,

CORRECTED TO SEPTEMBER, 1873.

Life Members are marked with an Asterisk.

Oct. 21, 1872	Abbott, Joseph, B.A., *Wavertree Vale, Wavertree-road*, and *Liverpool College, Shaw Street, Everton.*
Oct. 11, 1833	Aikin, James, 4, *Gambier-terrace.*
Nov. 4, 1867	Allen, John Fenwick, *Peasley Vale, St. Helens.*
March 7, 1864	Archer, F., jun., B.A., Trin. Coll., Cantab., *Daily Post Office, Lord-street.*
*Nov. 28, 1853	Archer, T. C., F.R.S.E., F.R.S.S.A., Director of the Industrial Museum, *Edinburgh.*
March 4, 1872	Armour, Matthew W., *Woolton Tower, Woolton Park, Woolton.*
Dec. 14, 1868	Ashe, Theop. Fielding, *Atherton-street*, and *Moss Bank, Lodge-lane.*
Feb. 22, 1855	Avison, Thomas, F.S.A., 18, *Cook-street*, and *Fulwood Park, Aigburth.*
Jan. 11, 1864	Bagshaw, John, 87, *Church-street*, and 26, *Bentley-road, Prince's Park.*
May 1, 1854	Bahr, G. W., *Old Castle Buildings, South Castle-street*, and 2, *South-hill Grove, Aigburth.*
May 4, 1868	Bailey, Fras. J., M.R.C.S., 51, *Grove-street.*

Jan. 13, 1862 Baruchson, Arnold, *Batavia Buildings, Hackins hey*, and *Blundell Sands, Great Crosby*, VICE PRESIDENT.

Nov. 15, 1869 Beer, Joseph B. de (A. Baruchson & Co.), *Batavia Buildings, Hackins-hey.*

March 9, 1857 Bell, Christopher, *Redcross-street*, and 55, *Hamilton-square, Birkenhead.*

Dec. 10, 1866 Benas, Baron Louis, 5, *South Castle-street.*

Nov. 14, 1864 Bennett, J. M., *Sir Thomas's-buildings*, and 109, *Shaw-street.*

Nov. 27, 1865 Biggs, Arthur Worthington, 6, *Liver Chambers*, 9, *Tithebarn-street*, and 106, *Bedford-street.*

Feb. 6, 1872 Biggs, John H. W., 6, *Windsor Buildings, George Street.*

Nov. 18, 1867 Biggs, Russell H. W., 23, *Castle-street*, and 24, *Canning-street.*

Oct. 31, 1859 Birch, Jas., *Messrs. Reiss Brothers, The Temple, Dale-street.*

Jan. 25, 1864 Birchall, James, Governor of the Liverpool *Industrial Schools, Kirkdale*, HON. SECRETARY.

April 15, 1861 Blake, James, 63, *Kitchen-street*, and 45, *Canning-street.*

March 9, 1866 Blood, William, *Chamber of Commerce*, and *Greta Mount*, 5, *Woodchurch-road, Birkenhead.*

Nov. 26, 1866 Boult, Joseph, 15 D, *Exchange Buildings West.*

*Mar. 6, 1835 Boult, Swinton, 1, *Dale-street*, and 71, *Bedford-street South.*

Oct. 19, 1868 Bower, Anthony, *Vauxhall Foundry*, and *Bowersdale, Seaforth.*

Oct. 21, 1872 Bowring, C. T., *Elmsleigh, Prince's Park*, and 20, *Lancaster Buildings, Tithebarn-street.*

Nov. 4, 1867 Bramwell, Ed., *Cowley Hill, St. Helens.*

Jan. 27, 1873 Bremner, H. H., 15, *Lord-street.*

*Jan. 8, 1855 Brockholes, James Fitzherbert, *Puddington Old Hall, near Neston.*

Nov. 12, 1866 Browne, Edgar A., 86, *Bedford-street South.*

Oct. 18, 1869 Brown, Dr. J. Campbell, D.Sc., F.C.S., *School of Medicine, Dover-street.*

Nov. 4, 1872 Buckmaster, Henry, 52, *Upper Parliament-street.*

Feb. 4, 1867 Burden, Edward, 128, *Upper Parliament-street.*

April 18, 1864 Burne, Joseph, *Royal Insurance Office,* 1, *North John-street,* and *Higher Tranmere.*

Nov. 12, 1866 Butler, Rev. George, *The College, Shaw-street.*

*May 1, 1848 Byerley, Isaac, F.L.S., F.R.C.S., *Victoria-road, Seacombe.*

Nov. 8, 1862 Cameron, John, M.D., M.R.C.P., Physician to the Southern Hospital, and Lecturer on Medicine at the Royal Infirmary School of Medicine, 17, *Rodney-street.*

Dec. 2, 1872 Carey, Eustace, *Appleton-in-Widnes, near Warrington.*

Jan. 9, 1865 Cariss, Astrup, 40, *Castle-Street.*

March 4, 1872 Carter, W., M. B. Lond., 74, *Rodney-street.*

Dec. 2, 1861 Chadburn, William, 71, *Lord-street.*

Dec. 1, 1851 Clare, John Leigh, *Borough Buildings,* 7, *Rum ford-street,* and *Hoylake.*

Oct. 31, 1859 Clark, Charles H., 17, *North John-street* and *Linden House, Rock Ferry.*

Jan. 26, 1868 Commins, Andrew, LL.D. Dub., *Eldon Chambers,* 20, *South John-street.*

Nov. 1, 1869 Cook, C. H. (Lamport & Holt), *Drury Buildings,* 21, *Water-street,* and *Blundell Sands.*

Oct. 18, 1869 Cook, Henry James, *Byrom-street,* and *Burbo House, Blundell Sands.*

Nov. 4, 1872 Coughtrey, Millen, M.B., Demonstrator of Anatomy Royal Infirmary School of Medicine, *Dover-street,* and 1, *Maryland-street.*

Oct. 6, 1868 Crosfield, William, Jun., 28, *Temple Court,* and *Alexandra-drive, Ullet-road.*

Feb. 6, 1872 Cudlipp, Ralph B., 57, *Catherine-street.*

Nov. 26, 1866 Curtis, Rev. F. H., M. A. Oxon., *The College, Shaw-street.*

Feb. 8, 1864 Cuthbert, J. R., 40, *Chapel-street*, and *White House, Out-lane, Woolton.*

Dec. 14, 1868 Daly, Denis, 11, *Rumford-street.*

Jan. 24, 1870 Dallinger, Rev. W. H., F.R.M.S., 10, *Green Lawn, Rock Ferry.*

Nov. 12, 1866 Davies, E., F.C.S., *The Laboratory, Royal Institution, Colquitt-street.*

Oct. 21, 1872 Davies, Rev. J. Alden, 6, *Newstead-road, Smithdown-lane.*

Nov. 2, 1863 Dawbarn, William, *The Temple, Dale-street*, and *Mosley-hill.*

Oct. 1, 1866 Dawson, Thomas, 26, *Rodney-street.*

Jan. 8, 1872 Deane, Charles Courtenay, 3, *York Buildings*, 14, *Dale-street*, and *Blundell Sands.*

March 9, 1868 Dixon, W., *Somerville House, Poulton-road, Seacombe.*

Nov. 27, 1863 Dove, John M., *Royal Insurance Office*, and *Claughton.*

Jan. 28, 1848 Drysdale, John James, M. D. Edin., M.R.C.S. Edin., 36, *Rodney-street.*

Feb. 4, 1856 Duckworth, Henry, F.L.S., F.R.G.S., F.G.S., 32, *Brown's Buildings, Exchange-street W.*

*Nov. 27, 1848 Edwards, John Baker, Ph. D. Gies., F.C.S., Professor Medical Faculty of Bishop's College, Montreal.

Mar. 21, 1870 Edwards, Edward E. (Smith, Edwards & Co.), *Adelaide Buildings*, 4, *Chapel-street.*

Feb. 24, 1868 Elliot, John, 35, *Peter's-lane.*

April 7, 1862 English, Charles J., 26, *Chapel-street*, and 26, *Falkner-square.*

*Dec. 18, 1852 Ferguson, William, F.L.S., F.G.S., *Kinmundy House, near Mintlaw, N. B.*

Feb. 9, 1863 Finlay, William, Senior Mathematical Master, Middle School, *Liverpool College*, and 310, *Shaw-street.*

Oct. 1, 1866 Fletcher, Alfred E., F.C.S., H. M. Inspector of

Alkali Works, for the Western District, 21, *Overton-street*, *Edge-hill*.

*Mar. 19, 1855 Ford, James Thomas, 5, *Essex-ct.*, *Temple*, *E.C.*

Dec. 2, 1872 Forwood, Wm. Bower (Messrs. Leech, Harrison, & Forwood), 16, *Queen's Buildings*, 11, *Dale-street*. and *Burbo Bank Road*, *Blundell Sands*.

*Feb. 6, 1854 Gee, Robert, M.D. Heidelb., M.R.C.P., Lecturer on Diseases of Children, Royal Infirmary School of Medicine; Physician, Workhouse Hospital, 5, *Abercromby-square*.

Nov. 14, 1858 Greenwood, Henry, 32, *Castle-street*, and *Stanley Park*.

Jan. 22, 1855 Hakes, James, M.R.C.S., Surgeon to the Northern Hospital, 80, *Hope-street*.

Oct. 21, 1872 Halliwell, Joseph, 10, *College Lane*.

Oct. 21, 1872 Hanley, John, *Victoria Park*, *Wavertee*.

*Jan. 21, 1856 Hardman, Lawrence, 85, *Rock Park*, *Rock Ferry*.

Nov. 15, 1869 Hartwig, Estevan H. L., 62, *Palmaille*, *Altona*, *Hamburg*.

Feb. 6, 1865 Hassan, Rev. E., *Alma-terrace*, *Sandown-lane*.

Oct. 21, 1872 Havelaar, Louis Willem, *Lance-lane*, *Wavertree*.

Nov. 13, 1865 Hayward, John Williams, M.D., 117, *Grove-street*.

Feb. 6, 1865 Hebson, Douglas, 18, *Tower-chambers*, and 58, *Bedford-street South*.

Nov. 4, 1872 Hicks, Sibley, F.R.C.S., 1, *Erskine-street*.

Dec. 28, 1846 Higgins, Rev. H. H., M. A. Cantab., F.C.P.S., *Rainhill*, Ex-President.

*Oct. 31, 1836 Higginson, Alfred, M.R.C.S., Surgeon Royal Southern Hospital, 44, *Upper Parliament-street*, Vice-President.

Mar. 22, 1869 Higgin, Thomas, 33, *Tower-buildings*, and *Huyton*.

Feb. 20, 1871 Highfield, Samuel, *Manor-road*, *Liscard*.

April 29, 1872 Hiles, Joseph (Gholson, Walker & Co.), *National Bank Buildings*, *Castle-street*, and *Sefton Villas*, *Rice Lane*, *Walton*.

Nov. 16, 1868 Holden, Adam, 48, *Church-street*, and 2, *Carlton terrace*, *Milton-road*.

March 9, 1868 Holme, James, jun., 109, *Mount Pleasant*.

*Dec. 14, 1862 Holt, Robert Durning, 6, *India-buildings*, and 29, *Edge-lane*.

*Nov. 18, 1854 Hunter, John, Member Historic Society, Pennsylvania, *Halifax*, *Nova Scotia*.

Jan. 26, 1857 Hutton, David, 8, *St. George's-crescent*, and 61, *Canning-street*.

*April 29, 1850 Ihne, William, Ph. D. Bonn, *Villa Felseck*, *Heidelberg*, Ex-President.

Feb. 23, 1857 Imlach, Henry, M.D. Edin., 1, *Abercromby-square*.

*Oct. 21, 1844 Inman, Thomas, M.D. Lond., M.R.C.P., Consulting Physician, Royal Infirmary, *Vyvyan-terrace*, *Clifton*, Ex-President.

Nov. 28, 1864 Jeffery, F. J., *Great George-street*.

Mar. 10, 1862 Johnson, Richard, *Queen Buildings*, and *Blundell Sands*.

Jan. 26, 1868 Johnson, Richard C., *Queen Buildings*, and *Blundell Sands*, Hon. Treasurer.

Feb. 24, 1868 Jones, Charles W., *The Nook*, *Gateacre*.

Nov. 26, 1866 Jones, Edward, B.A., Head Master of Hibernian School, *Mount Pleasant*.

*April 4, 1852 Jones, Morris Charles, F.S.A., F.S.A. Scot., 20, *Abercromby-square*.

May 5, 1851 Jones, Roger Lyon, *Liverpool and London-chambers*, *Exchange*, and 6, *Sunnyside*, *Prince's Park*.

Oct. 18, 1869 Jones, Wm. Bolton, 21, *South Castle-street*.

Oct. 7, 1872 Kelly, Frederick, *Blundell Sands Road East*, *Great Crosby*.

Oct. 2, 1865 Kendal, Robinson, 16, *Water-street*, and 178, *Bedford-street*.

Nov. 12, 1866 Kennedy-Moore, Rev. W., M.A., 151, *Canning-street*.

Nov. 15, 1869 King, Jos., 18, *Exchange-alley W.*, and *Trelearen House*, *Blundell-sands*.

Nov. 1, 1869 Kinsman, W. N., 8, *Derwent-road*, *Stoneycroft.*

Jan. 10, 1848 Lamport, Wiliam James, 21, *Water-street*, and *New Brighton.*

*Jan. 14, 1839 Lassell, William, F.R.SS. L. and E., F.R.A.S., 27, *Milton-street*, and *Wapping.*

Oct. 21, 1844 Lear, John, 14, *Cook-street*, and 22, *Holland-terrace*, *Marmaduke-street*, *Edge Hill.*

Dec. 11, 1871 Leigh, Richmond, M.R.C.S.E., 91, *Berkeley-street.*

Jan. 27, 1873 Levis, Julius, 23, *Grove Park.*

Nov. 2, 1868 Lloyd, James, Vice-Consul, Argentine Confederation, 16, *Wellfield-place*, *Peel-street*, *Prince's Park.*

*Oct. 21, 1844 M'Andrew, Robert, F.R.S., F.L.S., *Isleworth House*, *Isleworth*, *London*, Ex-President.

April 17, 1865 MacCheane, Wm., M.R.C.S., 47, *Shaw-street.*

April 20, 1868 Marples, David, *Lord-street* and *Cable-street*, and *Sandon-terrace*, 119, *Oxton-road*, *Birkenhead.*

Nov. 14, 1870 Marples, Joseph, 28, *Leece-street*, and *Fernlee*, 51, *Whetstone-lane*, *Tranmere.*

Feb. 24. 1868 Marsh, John, *Rann Lee*, *Rainhill.*

Jan. 21, 1839 Martin, Studley, 27, *Brown's-buildings*, and 177, *Bedford-street South.*

Feb. 20, 1871 Mason, Alfred H., F.C.S., 56, *Hanover-street*, and 311, *Upper Parliament-street.*

Feb. 5, 1844 Mayer, Joseph, F.S.A., F.R.A.S., F.E.S., 68, *Lord-st.*, and *Pennants House*, *Lower Bebington.*

Oct. 31, 1859 Moore, Thomas John, Corr. Mem. Z.S., Curator Free Public Museum, *William Brown-street*, Vice-President.

Nov. 2, 1868 Moore, J. Murray, M.D. Edin., 6, *Oxford-street.*

Nov. 15, 1869 Morgan, Alfred, 126, *London-road*, and 2, *Rathbone-terrace*, *Wellington-road*, *Wavertree*, Hon. Librarian.

Jan. 8, 1855 Morton, George Highfield, F.G.S., 122, *London-road.*

April 16, 1849 Moss, Rev. John James, B.A., *Upton, Cheshire.*

Oct. 29, 1850 Mott, Albert Julius, 32, *Church-street*, and *Claremont House, Seaforth*, President.

April 3, 1854 Mott, Charles Grey, 27, *Argyle-street, Birkenhead*, and *Cavendish-road, Birkenhead Park.*

Nov. 2, 1868 M'Coskry, W., 14, *Cook-street.*

Mar. 21, 1870 M'Quie, P. B., 12, *Preeson's-row*, and *Blundell Sands.*

*Oct. 21, 1867 Muspratt, E. K., *Seaforth Hall, Seaforth.*

Oct. 20, 1865 Nevins, John Birkbeck, M.D. Lond., M.R.C.S., Lecturer on Materia Medica, Royal Infirmary School of Medicine, 3, *Abercromby-square*, Ex-President.

April 7, 1862 Newlands, A., 5, *Brown's-buildings*, and 46, *Catherine-street.*

Feb. 6, 1865 Newton, John, M.R.C.S, 20, *Marmaduke-street, Edge Hill.*

Nov. 2, 1868 Norrie, Rev. B. A. W., M. A. Cantab., *Rainhill.*

*Oct. 15, 1855 North, Alfred, 28, *Lansdown-crescent, Notting-hill, London, W.*

Nov. 18, 1861 Nugent, Rev. James, 1, *Hornby-road, Walton.*

Dec. 10, 1866 Owen, Peter (Farnworth & Jardine), *Liverpool and London-chambers.*

Feb. 21, 1870 Packer, James Macnamara, M.D., *Rose Cottage, Poplar Bank, Huyton.*

Nov. 4, 1872 Page, Charles C., 28, *Clarence-street.*

Mar. 8, 1869 Parratt, Thos. P., 3, *Belvedere-road, Prince's Park.*

Jan. 9, 1871 Patterson, John, 16, *Devonshire-road, Prince's Park.*

Feb. 20, 1871 Pendlebury, Richard, B.A., *Fellow of St. John's College, Cambridge.*

Nov. 4, 1861 Philip, Thomas D., 48, *South Castle street*, and *Holly-road, Fairfield.*

Dec. 28, 1846 Picton, James Alanson, F.S.A., Chairman of the Library and Museum Committee, 11, *Dale-street*, and *Sandy-knowe, Wavertree*, Ex-President.

April 30, 1866 Prag, Rev. Jacob, 35, *Mount-street.*
Mar. 18, 1872 Pringle, Adam, *Grove Park.*
Nov. 13, 1871 Proctor, Peter, M.R.C.S., and L.S.A. Lond., 18, *St. James's-road.*
*Jan. 22, 1866 Raffles, William Winter, 54, *Brown's-buildings*, and *Sunnyside, Prince's Park.*
Nov. 12, 1860 Rathbone, Philip H., *Liverpool and London Chambers* (H), and *Greenbank Cottage, Wavertree.*
Mar. 24, 1862 Rathbone, Richard Reynolds, 17, *Lancaster-buildings, Tithebarn-street*, and *Beechwood House, Grassendale.*
*Jan. 7, 1856 Rawlins, Charles Edward, 12, *Rumford-court, Rumford-place*, and *Rock Mount, Rainhill.*
Jan. 9, 1870 Rawlins, Gerald W., *Brook Cottage, Rainhill.*
Oct. 17, 1870 Rayner, Joseph, Town Clerk, *Municipal Offices, Dale-street.*
*Nov. 17, 1851 Redish, Joseph Carter, 6, *Dingle-lane.*
Dec. 12, 1870 Rickard, Wm., L.L.D., *Alverton House*, 86, *Upper Parliament-street.*
Nov. 29, 1869 Roberts, Isaac, F.G.S., 26, *Rock Park, Rock Ferry.*
Feb. 4, 1867 Robinson, Joseph F., 9, *Orange-court.*
Oct. 4, 1869 Rogers, J. Frederick (Dart & Rogers), *The Temple, Dale-street*, and 8, *Onslow-road.*
April 18, 1854 Rowe, James, 16, *South Castle-street*, and 105, *Shaw-street.*
Jan. 22, 1872 Russell, Edward R., *Daily Post, Lord-street*, and 53, *Bedford-street.*
Feb. 20, 1865 Samuel, Albert H. (Evans, Son & Co.), 56, *Hanover-street*, and *Canning-terrace, Upper Parliament-street.*
April 7, 1862 Samuel, Harry S., 11, *Orange-court*, and 2, *Canning-street.*
Mar. 19, 1866 Sephton, Rev. John, M.A., *Liverpool Institute.*
Nov. 2, 1868 Sharp, Charles, *Liverpool Institute.*
Nov. 16, 1868 Sheldon, E. M., M.R.C.S., 228, *Boundary-street.*

Oct.	29, 1866	Shimmin, Hugh, 56, *Cable-street*, and *Tue Brook, West Derby.*
Nov.	2, 1868	Skillicorn, John E., 7, *The Willows, Breck-road.*
Nov.	7, 1864	Skinner, Thomas, M.D. Edin., *Dunedin House*, 64, *Upper Parliament-street.*
Feb.	28, 1868	Smith, J. Simm, *Royal Insurance Office, North John-street.*
Dec.	10, 1866	Smith, Elisha (Henry Nash & Co.), 5, *India-buildings.*
April	4, 1870	Smith, James, 11, *Lord-street.*
Feb.	24, 1862	Snape, Joseph, Lecturer on Dental Surgery, Royal Infirmary School of Medicine, 75, *Rodney-street.*
Nov.	12, 1860	Spence, Charles, 4, *Oldhall-street.*
Feb.	10, 1862	Spence, James, 18, *Brown's-buildings, Exchange*, and 10, *Abercromby-square.*
Nov.	27, 1865	Spola, Luigi, LL.D., 85, *Boundary-lane, West Derby-road.*
Nov.	29, 1869	Statham, H. H., jun., 5, *Batavia-buildings, Hackins-hey.*
Jan.	18, 1868	Stearn, C. H., 8, *Eldon-terrace, Rock Ferry.*
Jan.	9, 1865	Stewart, Robert E., L.D.S., R.C.S., Dental Surgeon, Royal Southern Hospital, and Liverpool Dental Hospital, 37, *Rodney-street.*
Oct.	18, 1858	Stuart, Richard, 11, *Manchester-buildings*, and *Brooklyn Villa, Breeze-hill, Walton.*
*Feb.	19, 1865	Taylor, John Stopford, M.D. Aberd., F.R.G.S., 1, *Springfield, St. Anne-street.*
Jan.	28, 1848	Taylor, Robert Hibbert, M.D. Edin., L.R.C.S. Ed., Lect. on Ophthalmic Medicine, Royal Infirmary School of Medicine, 1, *Percy-street.*
Nov.	4, 1872	Taylor, Whateley Cook, 10, *Cambridge-street.*
Nov.	17, 1850	Tinling, Chas., 44, *Cable-street*, and 29, *Onslow-road, Elm Park.*
Dec.	1, 1851	Towson, John Thomas, F.R.G.S., Scientific Examiner, Sailors' Home, 47, *Upper Parliament-street.*

Jan. 7, 1867 Trimble, Robt., *Cuckoo-lane, Little Woolton.*
*Feb. 19, 1844 Turnbull, James Muter, M.D. Edin., M.R.C.P., Physician Royal Infirmary, 86, *Rodney-street.*
Oct. 21, 1861 Unwin, William Andrew, 11, *Rumford-place.*
Oct. 21, 1844 Vose, James Richard White, M.D. Edin., F.R.C.P., Physician Royal Infirmary, 5, *Gambier-terrace.*
Dec. 2, 1872 Waite, William Henry, D.D.S., J.D.S., 10, *Oxford-street.*
Mar. 18, 1872 Walker, George E., F.R.C.S., 58, *Rodney-street.*
Mar. 18, 1861 Walker, Thomas Shadford, M.R.C.S., 82, *Rodney-street.*
Jan. 27, 1862 Walmsley, Gilbert G., 50, *Lord-street.*
Jan. 9, 1865 Walthew, William, *Phœnix Chambers*, and *Vine Cottage, Aughton.*
Mar. 4, 1872 Ward, Thomas, *Northwich.*
Dec. 13, 1869 Waterhouse, Harold, 37, *Catherine-street.*
Dec. 2, 1861 Weightman, William Henry, *Minster-buildings, Church-street*, and *Cambridge-road, Seaforth.*
April 7, 1862 Whittle, Ewing, M.D., Lecturer on Medical Jurisprudence, Royal Infirmary School of Medicine, 77 A, *Upper Parliament-street.*
Jan. 13, 1868 Whitworth, Rev. W. A., M.A., 185, *Islington.*
Jan. 8, 1872 Williams, Wellington A., 38, *Canning-street, E.*
Mar. 18, 1861 Wood, George S. (Messrs. Abraham & Co.) 20, *Lord-street*, and *Bellevue-road, Wavertree.*
Nov. 14, 1870 Wood, W. (Messrs. Abraham & Co.), 20, *Lord-street.*
Nov. 14, 1870 Wood, John J. (Messrs. Abraham & Co.), 20, *Lord-street.*
Oct. 17, 1870 Woodburn, Thos., 18, *Law Association Buildings*, 18, *Harrington-street, W.*

HONORARY MEMBERS.

LIMITED TO FIFTY.

1.—1838 The Right Hon. Dudley Ryder, Earl of Harrowby, K.G., D.C.L., F.R.S., *Sandon-hall, Staffordshire*, and 39, *Grosvenor-square, London, W.*

2.—1836 The Most Noble William, Duke of Devonshire, K.G., M.A., F.R.S., F.G.S., &c., Chancellor of the University of Cambridge, *Devonshire House, London, W.*, and *Chatsworth, Derbyshire.*

3.—1838 Sir George Biddell Airy, Knight, M.A., D.C.L., F.R.S., Hon F.R.S.E., Hon. M.R.I.A., V.P.R.A.S., F.C.P.S., &c., Astronomer Royal, *Royal Observatory, Greenwich.*

4.—1840 James Nasmyth, F.R.A.S., *Penshurst, Kent.*

5.—1841 Charles Bryce, M.D. Glasg., Fell. F.P.S.G., *Brighton.*

6.—1844 T. P. Hall, *Coggleshall, Essex.*

7.—1844 Peter Rylands, *Warrington.*

8.—1844 John Scouler, M.D., LL.D., F.L.S., *Glasgow.*

9.—1844 Thomas Rymer Jones, F.R.S., F.Z.S., F.L.S., Professor of Comparative Anatomy, *King's College, London.*

10.—1844 Sir Charles Lemon, Bart., M.A. Cantab., F.R.S., F.G.S., *Penrhyn, Cornwall.*

11.—1844 William Carpenter, M.D. Edin., F.R.S., F.L.S., F.G.S., Registrar, *London University.*

12.—1848 Rev. Thomas Corser, M.A., *Strand, Bury.*

13.—1850 Rev. Canon St. Vincent Beechy, M.A. Cantab., *Hilgay Rectory, Downham, Norfolk.*

14.—1851 James Smith, F.R.SS.L. and E., F.G.S., F.R.G.S., *Jordan-hill, Glasgow.*

15.—1851 Henry Clarke Pidgeon, *London.*

16.—1851 Rev. Robert Bickersteth Mayor, M.A., Fell. of St. John's College, Cantab., F.C.P.S., *Rugby.*

17.—1852 William Reynolds, M.D., *Beech Lawn, Mossley Hill, Liverpool.*

18.—1853 Rev. James Booth, LL.D., F.R.S., &c., *Stone, near Aylesbury.*

19.—1857 Thomas Jos. Hutchinson, F.R.G.S., F.R.S.L., F.E.S., H.B.M. Consul, *Callao, Peru.*

20.—1861 Louis Agassiz, Professor of Natural History in Harvard University, *Cambridge, Massachusetts.*

21.—1861 Sir William Fairbairn, Bart., LL.D., C.E., F.R.S., *Polygon, near Manchester.*

22.—1861 Rev. Thomas P. Kirkman, M.A., F.R.S., *Croft Rectory, Warrington.*

23.—1865 The Right Rev. H. N. Staley, D.D., Bishop of Honolulu, *Sandwich Islands.*

24.—1863 Edward J. Reed, C.B., *Hull.*

25.—1865 John Edward Gray, Ph. D., F.R.S., &c., *British Museum.*

26.—1865 George Rolleston, M.D., F.R.S., Linacre Professor of Physiology in the University of Oxford, *Oxford.*

27.—1865 Cuthbert Collingwood, M.A. and M.B. Oxon, F.L.S.

28.—1867 J. W. Dawson, LL.D., F.R.S., F.G.S., &c., Principal and Vice-Chancellor of McGill University, *Montreal.*

29.—1868 Captain Sir James Anderson, *Atlantic Telegraph Company, London.*

30.—1870 Sir John Lubbock, Bart., M.P., F.R.S., *High Elms, Farnborough, Kent.*

31.—1870 Henry E. Roscoe, F.R.S., Professor of Chemistry in Owen's College, *Manchester.*

32.—1870.—Professor Joseph Henry, Secretary to the Smithsonian Institute, *Washington, U.S.*

33.—1870 Professor Wyville Thompson, F.R.S., *Belfast.*

84.—1870 Joseph Hooker, M.D., F.R.S., *Royal Observatory, Kew.*

85.—1870 Professor Brown-Séquard, M.D.

86.—1870 John Gwyn Jeffreys, F.R.S., 25, *Devonshire-place, Portland-place, London.*

87.—1870 Thos. H. Huxley, LL.D., F.R.S., Professor of Natural History in the Royal School of Mines, *Jermyn-street*, and 26, *Abbey-place, St. John's-wood, London.*

88.—1870 John Tyndall, LL.D., F.R.S., Professor of Natural Philosophy in the Royal Institution, *London.*

89.—1870 Rev. Christian D. Ginsburg, LL.D., *Binfield, Bracknell, Berks.*

CORRESPONDING MEMBERS.

LIMITED TO THIRTY-FIVE.

1.—1867 Albert C. L. G. Günther, M.A., M.D., Ph.D., British Museum, Editor of the "Zoological Record."

2.—1867 J. Yate Johnson, *London.*

3.—1867 R. B. N. Walker, *Gaboon, West Africa.*

4.—1868 Rev. J. Holding, M.A., F.R.G.S., *London.*

5.—1868 Geo. Hawkins, *Colombo, Ceylon.*

6.—1868 J. Lewis Ingram, *Bathurst, River Gambia.*

7.—1869 George Mackensie, *Cebu, Philippine Islands.*

8.—1870 Rev. Joshua Jones, D.C.L., King William's College, *Isle of Man.*

ASSOCIATES.

LIMITED TO TWENTY-FIVE.

1.—Jan. 27, 1862 Captain John H. Mortimer, "America," (Atlantic.)

2.—Mar. 24, 1862 Captain P. C. Petrie, "City of London," Commodore of the Inman Line of American Steam Packets (Atlantic.)

3.—Feb. 9. 1863 Captain James P. Anderson, R.M.S.S. "Africa," Cunard Service. (Atlantic.)

4.—Feb. 9, 1863 Captain John Carr (Bushby & Edwards), ship "Scindia." (Calcutta.)

5.—Feb. 9, 1863 Captain Charles E. Price, R.N.R. (L. Young & Co.), ship "Cornwallis." (Calcutta and Sydney.)

6.—April 20, 1863 Captain Fred. E. Baker, ship "Niphon." (Chinese Seas.)

7.—Oct. 31, 1864 Captain Thomson, ship "Admiral Lyons." (Bombay.)

8.—Oct. 31, 1864 Captain Alexander Browne (Papayanni) S.S. "Agia Sofia." (Mediterranean.)

9.—April 18, 1865 Capt. Alexander Cameron (Boult, English & Brandon), ship "Staffordshire." (Shanghai.)

10.—Dec. 11, 1865 Captain Walker, ship "Trenton."

11.—Mar. 28, 1868 Captain David Scott.

12.—Oct. 5, 1868 Captain Cawne Warren.

13.—Oct. 5, 1868 Captain Perry.

14.—Mar. 22, 1869 Captain Robert Morgan, ship "Robin Hood."

15.—April 29, 1872 Captain J. B. Walker, Old Calabar.

16.—April 29, 1872 Captain Alfred Horsfall, S.S. "Canopus."

ADDITIONS TO THE LIBRARY.

DATE ANNOUNCED.

1872.

NOVEMBER 4TH. PRESENTED BY

Journal, Chemical Society of London, nos. 112–116, April to August, 1872 . . *The Society.*

Proceedings, Franklin Institute of Philadelphia, vol. 63, Jan. to June 30th, and parts for July and August, 1872 . . . *The Institute.*

Proceedings, Zoological Society of London, 1871, parts 2 and 3, 1872, part 1 . . *The Society.*

Revised List of Vertebrated Animals in the Zoological Society's Gardens, London, 1872 *The Society.*

Journal, Royal Geographical Society of London, vol. 16, no. 2, February, 1872; Proceedings, vol. 16, no. 2, February, 1872 . . *The Society.*

Clark's Ante-Nicene Christian Library; the Writings of Origen, vol. 2; Early Liturgies, one vol. . . . . *R. A. Macfie, Esq., M.P.*

Report, Smithsonian Institute, Washington, 1870 *The Institute.*

Journal, East Indian Association of London, vol. 6, no. 2 . . . . *The Association.*

Proceedings, Society of Antiquaries of London, vol. 5, no. 3, June, 1871 . . . . *The Society.*

Proceedings, Architectural and Archæological Society of Liverpool, 24th Session, 1872 . *The Society.*

Proceedings, Manchester Literary and Philosophical Society, part for April, 1872 . . *The Society.*

Monthly Notices, Royal Astronomical Society, April, May, and June, 1872 . . . *The Society.*

Journal, Scottish Meteorological Society, Edinburgh, nos. 33–35, January, July, 1872 . *The Society.*

Proceedings, Linnæan Society, London, part 1, 1871-2 . . . . *The Society.*

Journal, ditto, vol. 13, 1872 . . . *The Society.*

Quarterly Journal, Anthropological Institute of London, for April, 1872 . . . . *The Institute.*

Proceedings, Royal Society, London, vol. 20, nos. 133-6, 1872 . . . . . . *The Society.*

Correspondence concerning the Great Melbourne Telescope, 1 vol. . . . . *The Royal Society.*

Quarterly Journal, Statistical Society of London, vol. 35, part 2, June, 1872 . . *The Society.*

Proceedings, Essex Institute, Salem, Mass., vol. 6, part 3, 1868-71 . . . . . *The Institute.*

Bulletin, Essex Institute, vol. 3, 1871 . . *The Institute.*

Annual Report, Museum of Comparative Zoology, Harvard College, Cambridge, Mass., 1872 . *The Senate.*

NOVEMBER 18TH.

Transactions, Clinical Society of London, vol. 5, 1871-2 . . . . *The Society.*

Health and Comfort in House Building, by Dr. Hayward and Dr. Drysdale . . . *The Authors.*

Report of the Astronomer to the Marine Committee of the Mersey Docks and Harbour Board . . . *John Hartnup, Esq. F.R.A.S.*

Memoires de la Société Nationale des Sciences Naturelles de Cherbourg, tome 16, 1871-72, and three Papers . . . . . . *The Society.*

Memoire del Reale Instituto Lombardo di Scienze a Lettere — Milan . . .

I. Classe de Scienze Mathematiche e Naturali, vol. 12; fasciole 2, 3, 4, 1871-2 . . .

II. Classe de Lettere e Scienze Morali e Politiche, vol. 12; fasciole 2 . . . . .

III. Rendiconti, vols. 3, 4, 5; fasciole, 16-20; fasciole 1-20; fasciole 1-7 . . . *The Institute*

DECEMBER 2ND.

Proceedings, Royal Geographical Society of London, vol. 16, no. 3, July, 1872 . . *The Society.*

Monthly Notices, Royal Astronomical Society of London, no. 9 . . . . . *The Society.*

Quarterly Journal Anthropological Institute, October, 1872; also List of Members of the Institute . . . . . . *The Institute.*

Proceedings, Royal Society of London, no. 137 *The Society.*

Proceedings, Liverpool Geological Society, vol. 13, 1871–72 . . . . . . *The Society.*

Proceedings, Geological and Polytechnical Society of the West Riding of Yorkshire, Leeds, 1871–72 . . . . . *The Society.*

Report, Leeds Literary and Philosophical Society, 1871–72 . . . . . *The Society.*

Report, Birkenhead Literary and Scientific Society, 1871–72 . . . . . *The Society.*

DECEMBER 16TH.

Report, British Association, Edinburgh Meeting, 1871 . . . . *Dr. Inman.*

Journal, Chemical Society of London, nos. 117–19, 1872 . . . . *The Society.*

Journal, Linnæan Society of London, Zoology, vol. 11, part 55 . . . . . *The Society.*

Proceedings, Royal Society of London, No. 138, to complete vol. 20, 1872 . . . . *The Society.*

Journal, Society of Arts, nos. 1014, April 26, 1043, Nov. 14, to complete vol. 20, 1872 . *The Society.*

Annual Report, Free Public Library of Manchester, 1871–72 *Mayor and Corporation of Manchester.*

1873.—JANUARY 13TH.

Journal, Chemical Society of London, No. 120, December, 1872 . . . . . . *The Society.*

Journal, Franklin Institute of Philadelphia, parts for September and October, 1872 . . *The Institute.*

Proceedings, Royal Geographical Society of London, vol. 16. no. 4, containing Sir H. Rawlinson's Address, and the Catalogue of the Society's Library . . . . *The Society.*

Proceedings, Architectural and Archæological Society of Liverpool, 25th Session, First Meeting, October 2nd, 1872 . . . *The Society.*

Monthly Notices, Royal Astronomical Society of London, vol. 33, no. 1, for November, 1873 *The Society.*

Journal, Linnæan Society of London, Botany, Part for December . . . . . . *The Society.*

Quarterly Journal, Statistical Society of London, part 3, vol. 35 . . . . *The Society.*

Quarterly Journal, Meteorological Society of London, for October . . . . . *The Society.*

Journal, Royal Asiatic Society of London, vol. 6, part 1, 1872 . . . . *The Society.*

Transactions, Edinburgh Geological Society, vol. 2, part 1, 1872 . . . . . *The Society.*

Transactions, Medico-Chirurgical Society, London, vol. 55, 1872 . . . . *The Society.*

JANUARY 27TH.

Kongliga Svenska Vetenskaps Akademiens-Handlingar, 3 vols., 1868–69 . . . *The Academy.*

Lefnadsteckningar, band 1, hafte 2, 1870 . *The Academy.*

Schriften der Königlichen Physikalisch Akademiens zu Konigsberg . . . . . . *The Society.*

Eilfter Jahrgang, 1870.

Zwölfter Jahrgang, 1871.

Dreizehnter Jahrgang, 1872.

On the Restoration of Health, by Dr. Inman . *The Author.*
On the Preservation of Health, by Dr. Inman . *The Author.*
Annual Report of the Liverpool Free Public Library, Museum, &c., 1872 . . .
The Library, Museum, and Arts Committee.
Three copies of the Tri-daily Bulletin of 25th Nov. 1872, and three copies of the Tri-daily Weather Map of the same date, issued by the Chief Signal Officer, War Department, Washington . . . *United States Government.*
Statistics of Telegraphy, by Sir James Anderson, London, 1872 . . . . *The Author.*
The Policy of Quarantine, as applied to Cholera and Cattle Plague, by George Foggo . . *The Author.*
Annual Report and Transactions, Plymouth Institution and Devon and Cornwall Natural History Society, vol. 4, part 3, 1872 . . *The Society.*
Flora of Devon and Cornwall, by I. N. W. Keyes, part 5, Labiatæ Characeœ . . . *The Author.*
Mosses of Devon and Cornwall, by E. M. Holmes and F. Brent; also Scale Mosses, Liver Mosses, and Lichens of Devon and Cornwall, by E. M. Holmes; in 1 vol. . *The Authors.*

FEBRUARY 10TH.

Journal, Chemical Society of London, No. 121, 1873 . . . . *The Society.*
Journal, Franklin Institute of Philadelphia, vol. 64, part 6, Dec. 1872 . . . . *The Institute.*
Journal, East Indian Association, London, vol. 6, part 3, 1872 . . . . . . *The Association.*
Proceedings, Society of Antiquaries of London, vol. 5, part 4, June, 1871, to January, 1872 *The Society.*
Proceedings, Royal Society of London, vol. 32, parts 139 and 140, Dec. 1872, Jan. 1873 . *The Society.*

Journal, Statistical Society, London, vol. 85, part 4, Dec. 1872 . . . . . . *The Society.*

Monthly Notices, Royal Astronomical Society London, vol. 85, no. 2, Dec. 1872 . . *The Society.*

FEBRUARY 24TH.

Catalogue of Books in Free Public Library, Liverpool, to end of 1870, compiled by S. Huggins . *The Library, Museum, and Arts Committee.*

Transactions, Liverpool Numismatic Society, part 1, 1872 . . . . *The Society.*

Proceedings, Liverpool Architectural and Archæological Society, Third and Fourth Meetings, 1872 . . . . *The Society.*

Canadian Journal of Arts, Sciences, &c., Toronto, vol. 18, part 5, 1872 . . . . *Canadian Institute.*

Natural History Transactions of Northumberland and Durham, Newcastle-on-Tyne, vol. 6, part 2, 1872 . . . . *The Society.*

MARCH 24TH.

Journal, Chemical Society, London, February, 1873 . . . . *The Society.*

Journal, Franklin Institute, Philadelphia, January and February, 1873 . . . . *The Institute.*

Monthly Notices, Royal Astronomical Society, London, No. 141 . . . . . . *The Society.*

Quarterly Journal, Meteorological Society, London, January, 1873 . . . . . . *The Society.*

APRIL 21ST.

Journal, Chemical Society, London, No. 124, March, 1873 . . . . *The Society.*

Proceedings of the Zoological Society of London, part 2, June, 1872 . . . . . . *The Society.*

Index to Ditto, 1861 to 1870 . . . *The Society.*

Proceedings of the Royal Geographical Society, London, December, 1872 and February, 1873 *The Society.*

Proceedings, Society of Antiquaries, London, vol. 5, part 5, May, 1872 . . . . *The Society.*

Proceedings, Architectural and Archæological Society of Liverpool, January, 1873 . . *The Society.*

Monthly Notices, Royal Astronomical Society, London, February, 1873 . . . . *The Society.*

Journal, Scottish Meteorological Society, Edinburgh, no. 36, October, 1872 . . *The Society.*

Journal, Anthropological Institute, London, no. 6, January, 1873 . . . . . *The Institute.*

Proceedings, Royal Institution, London, vol. 6, parts 5 and 6 . . . . . *The Institution.*

TREASURER'S ACCOUNT, 1871-2.

Dr. *The Literary and Philosophical Society, in Account with the Treasurer.* Cr.

1871-2.		£ s. d.
To Cash paid Mr. Marples, for Printing,		148 19 10
" " Mr. Tinling, do.		9 15 6
" " Secretary's Expenses		13 5 6
" " " Editorial Fee		10 10 0
" " Mrs. Johnson		22 11 10
" " Waiters' Attendance		2 5 0
" " Moab Expedition		10 0 0
" " Mr. Macindoe, lithographer		1 2 6
" " Stamp, Trust Deed		0 10 0
" " Postages		0 14 0
" " Walmsley, Binding		24 6 11
		244 1 1
1872-		
Oct. 7.—Balance in hand, viz., Dock Bonds	250 0 0	
Cash	31 10 10	
		281 10 10
		£525 11 11

1871.		£ s. d.
Oct.—By Balance from last Account—		
In Dock Bonds	£250 0 0	
Cash in Treasurer's hands	68 13 7	
		318 13 7
By Annual Subscriptions, viz.—		
148 at 21s.	155 8 0	
8 at 10s. 6d.	4 4 0	
Entrance Fees—15 at 10s. 6d.	7 17 6	
Arrears—24 at 21s.	25 4 0	
		192 13 6
By Cash, Interest on Dock Bonds, less Income Tax		10 11 4
" Proceedings sold		3 13 6
		£525 11 11

Examined and found correct,

ISAAC ROBERTS,
EDWARD DAVIES.

PROCEEDINGS

OF THE

LIVERPOOL

LITERARY AND PHILOSOPHICAL SOCIETY.

ANNUAL MEETING.—Sixty-Second Session.

Royal Institution, October 7th, 1872.

ALBERT JULIUS MOTT, President, in the Chair.

The Minutes of the last Meeting of the previous session having been read and signed, the retiring President, Dr. Nevins, vacated the Chair in favour of his successor.

The Rev. H. H. Higgins then moved—"That the thanks of the Society be given to Dr. Nevins, for his eminent services during the time he has held the office of President."

The motion was seconded by Mr. J. A. Picton, who spoke in very complimentary terms of the late President's conduct in the Chair. The motion was carried unanimously.

Dr. Nevins then acknowledged the compliment.

The Honorary Secretary then read the following

REPORT.

The Report which the Council have now to present of the sixty-first Session is, like its predecessors, a simple record of continued prosperity, and of the interest taken in the Society's proceedings.

With regard to its material prosperity, the members are already aware that the Society has been able, on more than one occasion, to promote the objects of science and literature

by liberal votes of its funds. During the past Session, the expedition set on foot by the British Association, for the purpose of exploring Moab and the country East of the Dead Sea, was thus assisted, while two of the exploring party, the Rev. Dr. Ginsburg and Mr. R. C. Johnson, were members of the Society.

In furtherance also of the same objects, the Annual Roscoe Lecture has been instituted; but the first of the series was unavoidably postponed, in consequence of the sudden illness of the intended lecturer, Professor Max Müller.*

During the course of the past Session, the Society presented complete sets of its *Proceedings* to the cities of Chicago and Strasbourg, in aid of the general effort which was then made throughout the United Kingdom to replace the public libraries of those cities, destroyed by fire and the operations of war.

A complete index to the first twenty-five volumes of the *Proceedings* has been prepared and presented to the Society by Mr. Alfred Morgan, the Honorary Librarian, and will be inserted in the volume now forthcoming (vol. xxvi).

The number of ordinary members on the Society's list at the opening of last Session was 198. During the Session, and up to the present date, this number has been reduced by 11, of whom 1 only is deceased, viz., Mr. James Smith, of Seaforth, whose mathematical attainments and peculiar views on the quadrature of the circle are well known. Within the same period, 14 members have been admitted, so that there are now 201 ordinary members on the roll.

The number of honorary members is now 42; the two names taken off the list being those of Professor Paterson, of Belfast, well known by his work, *Zoology for Schools*, and Sir Roderick Impey Murchison, Bart.

* This Lecture was delivered on the 10th December, 1872. An abstract of it will be found at page xlii.

The list of corresponding members remains unchanged, and contains 8 names. One of the associates on last year's list, viz., Captain Whiteway,* is dead; two others, viz., Captains Walker and Horsfall, have since been elected, and the number of members of this class is now 16.

The following gentlemen are proposed for nomination on the Council for the ensuing Session:—Messrs. Isaac Roberts, Prag, Towson, Walthew, and Biggs.

The Treasurer's accounts were next read, and passed unanimously.

The election of office bearers and members of council followed, when

1.—The three Vice-Presidents were re-elected.

2.—The Honorary Secretary and the Honorary Librarian were also re-elected.

3.—Mr. R. C. Johnson was appointed Honorary Treasurer, in the place of Mr. A. J. Mott, elected President.

The following five gentlemen, nominated by the Council according to the laws, were balloted for, and duly elected on the Council:—Mr. Isaac Roberts, F.G.S., Rev. Jacob Prag, John Thomas Towson, F.R.G.S., William Walthew, Russell H. W. Biggs.

A ballot was then taken for nine other members of Council, when the following gentlemen were elected:—Alfred E. Fletcher, F.C.S., J. Campbell Brown, D. Sc., Edward Davies, F.C.S., Ewing Whittle, M.D., George S. Wood, Harry S. Samuel, Rev. W. Kennedy-Moore, M.A., Jos. F. Robinson, and Rev. W. H. Dallinger, F.R.M.S.

The Associates were then re-elected.

Mr. Frederick Kelly, proposed by Dr. Hayward, and seconded by the Secretary, was also elected an Ordinary Member.

* For obituary notice of Captain Whiteway's services in the cause of Science, see *Proceedings*, Vol. XXVI., p. xlv.

After the conclusion of the above business, the Meeting was adjourned to the Lecture Theatre, when the President read his Inaugural Address, which will be found at length in another part of the volume.*

FIRST ORDINARY MEETING.

Royal Institution, October 21st, 1872.

ALBERT JULIUS MOTT, President, in the Chair.

Messrs. Louis Willem Havelaar, John Hanley, C. T. Bowring, Joseph Abbott, and the Rev. J. Alden Davies were balloted for, and were unanimously elected Ordinary Members.

Captain J. B. Walker, an Associate, was introduced by Mr. T. J. Moore, and exhibited a number of curiosities, manufactured, in accordance with funereal rites, by native women in the neighbourhood of Old Calabar, during the long period of forced seclusion after the death of the chief, their husband.

Mr. Picton called the attention of the Meeting to the collection of Napoleonic Miniatures which had now become the property of the town, through the demise of Miss Mather, of Mount Pleasant. The collection would be deposited in the Museum.

He also introduced Mr. Chas. W. Goodwin, late judge at Shanghai, who was now engaged in deciphering the Egyptian MSS, in the Mayer Collection in the Museum. Mr. Goodwin then described the contents of two of the papyri he had examined; they were of a judicial character, and set forth the

* See page 1.

examinations of a number of persons relative to a robbery committed at the tomb (or some other building) of the Kings Seti I., and Rameses II.

After a variety of other miscellaneous communications, Mr. Richard C. Johnson, Honorary Treasurer, read a Paper "On the Exploration of Moab," which he illustrated with an extensive series of original photographs, exhibited by the lime light.*

SECOND ORDINARY MEETING.

Royal Institution, November 4th, 1872.

ALBERT JULIUS MOTT, President, in the Chair.

The President submitted forms of balloting papers for election of Ordinary Members, which were approved of and adopted at the Meeting.

A letter was read from the Secretary of the Polytechnic Society, inviting any Members of the Literary and Philosophical Society, who felt disposed, to attend at the next Meeting, the 25th instant, to hear Major General Scott describe his process of treating the Sewage of Towns, and utilising the proceeds.

Mr. T. J. Moore exhibited a stuffed specimen of a young Seal, which had been captured soon after birth in the caves of Achill, on the West coast of Ireland, by Mr. Thomas Higgin, in the first week of October last, and presented by him to the Museum. It lived only a few days, and examination of the skull after death showed it to be a Grey Seal (*Halichærus grypus*). Like the cubs of some other species, the fur of this young specimen is creamy white.

* See page 307.

Dr. HAYWARD also exhibited some Fangs of the Rattlesnake.

Messrs. H. Buckmaster, Joseph Halliwell, Whately Cook Taylor, Sibley Hicks, F.R.C.S., Charles C. Page, and Millen Coughtrey, M. B., were balloted for, and duly elected Ordinary Members.

The Rev. THOMAS P. KIRKMAN, M.A., F.R.S., then read a Paper on "Philosophy without Assumptions," which was followed by a brief discussion.*

THIRD ORDINARY MEETING.

ROYAL INSTITUTION, November 18th, 1872.

ALBERT JULIUS MOTT, PRESIDENT, in the Chair.

A communication was received from the Council, notifying the arrangements which had been made concerning the Roscoe Lecture.

The PRESIDENT then opened a conversation on Dr. Bastian's "Theory of the Origin of Life," and was followed by Messrs. Newton, Inman, Roberts, Carter and Fletcher, in the course of which it was mentioned that the Rev. W. H. Dallinger was now making some experiments, and that he would probably report the results to this Society.

Dr. INMAN showed a fragment of wood taken from a crag at Biarritz, about thirty feet above high water mark. It was embedded in rock, which was replete with fossil shells and echini, was of considerable size, about two feet by four

* See page 65.

inches, and when freshly extracted was perfectly soft. Examined by the microscope, the structure resembled that of the tree fern. Since having had it in his possession, the piece had become too hard and brittle for a section to be made satisfactorily.

Dr. INMAN next showed a cockle and oyster shell, stating that there was a layer of such shells about ten feet below the present surface of the ground, close to the Church of Trinita del Monte, at Rome. The ancient city occupied the crater of an extinct volcano, and about two-thirds of the crateric lip could easily be traced ; it was the highest near the Church named, and formed almost a perfect semicircle. A road had been cut which showed the volcanic nature of the country, and when the traveller had attained the summit of the elevation, and began to descend towards the north, he could recognise that he was on the outer surface of the crater, by the inclination of the strata of tufa, pumice ashes, and other volcanic products. Going forwards, the pedestrian begins to ascend again, and by roadside sections finds that he is passing through the lip of a second crater, in which no shells or other marine products are to be seen. This northern volcano probably had a diameter of ten miles, and was older than its southern neighbours. The existence of a layer of seashells, although it was only about two or three inches in thickness, showed that the Roman volcano had been either surrounded by the sea, or had one part of it exposed to the ocean, as had Stromboli, in the Lipari Isles. Dr. Inman had himself not only seen the shells in situ, but had extracted those which he showed from parts of the crateric lip which were about a mile and a half apart. All the shells that he had seen resembled modern ones, and seemed almost recent. The Via Appia, he also remarked, ran along a stream of lava which had flowed from the Alban volcano, towards Rome.

Dr. INMAN next exhibited a chipping from the recently rediscovered stalagmite cave of Adelsberg. In reference to the latter, he stated that during the last fifteen years one of the stalagmites had been carefully watched where the water from the limestone above dropped on to it, and a deposit equal only to the thinnest India paper had formed in that period. The largest stalagmites were sixty feet in height, and taking the same rate of production for these, we arrived at an existence of the cave for four millions of years, while an anterior period must be allowed for the formation of the limestone layer above from which the water dropped.

Mr. ANTHONY BOWER said he had been at the cave, and the deposit went on very rapidly in some parts of the cave, and very slowly in others, so that we must take with precaution such an inference as that of Dr. Inman's as to the antiquity of the deposit.

Mr. MOORE exhibited a drawing of a living specimen of a blind crayfish (*Cambarus pellucidus?*) of the Mammoth caves of Kentucky, expressly brought for the museum aquarium by Mr. J. Frederick Bowman, of London. Mr. Bowman obtained two others, and one blind fish, which unfortunately died during the journey.

Mr. THOMAS WARD then read a paper on the Salt district of Cheshire.*

After the reading of the paper, the President opened the discussion, and said that one of the most remarkable instances of the present day of the formation of salt by evaporation was in the Black Gulf of the Caspian Sea, into which it was calculated that water containing three hundred and fifty thousand tons of salt was driven daily, and did not escape, the deposit going on upon the shores of the gulf. Mr. J. T. Towson said that this question of the

* See page 39.

formation of salt was intimately connected with the continued existence of the Suez Canal. It was found that the salt waters of the Red Sea and the Mediterranean were continually flowing into the canal, without any apparent outlet, and that crystals of salt were forming in the bed of the canal. In the interests of commerce, he trusted that this process would not ultimately choke up the canal, and render it useless, but he had great anxiety upon the subject. Dr. Inman remarked that the salt water found its outlet probably by evaporation from the large inland salt lake of Timsah, through which the course of the canal lay.

FOURTH ORDINARY MEETING.

Royal Institution, December 2nd, 1872.

ALBERT JULIUS MOTT, President, in the Chair.

The following gentlemen were balloted for and duly elected Ordinary Members. Dr. Waite, and Messrs. Eustace Carey and Wm. Bower Forwood.

The President alluded tó the death of Mrs. Somerville, the well known scientific writer, which occurred in Italy a few days ago. She was an honorary fellow of the Astronomical Society, and only one other lady, besides herself, had enjoyed that title. Mr. Mott also referred to Mr. Picton's new book, *Memorials of Liverpool*. The society naturally took an interest in the achievements of its members, and he was sure the appearance of Mr. Picton's book was a matter of congratulation to the society, as well as to Mr. Picton himself.

Mr. Alfred E. Fletcher informed the meeting that

Lieut. Grundy and his brother, who were the only two white men appointed to conduct the Congo expedition, sailed on Saturday for Sierra Leone. Here they were to collect their men and go forward to St. Paul de Loando, whence they intended to start early in February for Congo. It was thought by many persons that the water-shed lately reached by Dr. Livingstone was that of the Congo, not of the Nile. Arrangements were made for bringing home samples of water from the sources of any of the principal rivers that might be reached, and tubes were provided for bringing home air from many of the marshy places.

Mr. J. N. Shoolbred (Honorary Secretary of the Polytechnic Society) exhibited and explained the meteorological marine charts of the Board of Trade. The Royal Society was anxious to enlist the service of volunteers in the publication of these charts, and would place at the disposal of any seaman or naval gentleman, willing to take observations, a full set of standard instruments. Some time had elapsed since this offer was made, but as yet scarcely a hundred masters of vessels had availed themselves of it. The object of the charts is to show, within a square of ten degrees, the state of wind, calm, currents, etc., in the Atlantic.

Mr. Johnson, referring to the late shower of meteors, said it was conclusively established that they were in the track of Biela's comet, which had been looked for during the last seven or eight weeks with considerable interest by astronomers.

Mr. J. T. Towson then made some observations on the Marine Charts, which he stated would be more useful to Liverpool mariners if brought to the higher latitudes, from 40° to 50° north. He also spoke of the meteors, the focus of which he stated to be near the Pleiades.

Mr. G. H. Morton then read a paper on "The Strata

below the Trias in the country around Liverpool, and the probability of coal occurring at a moderate depth."*

EXTRAORDINARY MEETING.

CONCERT ROOM, ST. GEORGE'S HALL, Dec. 10th, 1872.

This Meeting was held for the delivery of the First Roscoe Lecture, by Professor MAX MULLER, on "Darwin's Philosophy of Language."

The Chair was occupied by Mr. ALBERT J. MOTT, President, who was accompanied to the platform by a large number of the Members, while there was a large attendance in the body of the Hall, about one-half of the audience being ladies.

The CHAIRMAN said his duty, as President of the Society, was a most agreeable one, in introducing to them Professor Max Müller. Professor Müller's name and writings were known wherever literature was studied, and it was highly gratifying to them that he should come that night, he believed for the first time, before a Liverpool audience, to deliver their first Roscoe Lecture. The Roscoe Lecture had been founded by the Society, and had been named after William Roscoe, one of their earliest Members, who for many successive years occupied the President's chair of the Society. When the foundation of the Lectures had been determined upon, and when they had to consider what they should call them, it was felt that nothing could be more fitting than to give them the name of Roscoe, while, at the same time, they should be making the lectures a suitable, and they hoped a permanent, memorial to the man who first made that name illustrious. It had not been sought

* See p. 157.

to establish popular lectures in this case, or to address any but the best intellect in the town; but the object had been to give to members of the Society, and with them others who might desire it, an opportunity of hearing in Liverpool, once a year, an original discourse upon some subject of the highest interest in literature or philosophy, delivered by one of the most distinguished men of the day. These conditions would be fulfilled on the present occasion. No subject could have a deeper interest than the great gift of speech; nor could they have chosen a more distinguished man to address them on that subject. They had come to hear Professor Müller, and not to speak themselves; and as Professor Müller knew more about human language than any one else, he should at once ask him to use it at his pleasure.

Professor Müller, who was most cordially received, then proceeded with his lecture, and, in his preliminary observations, said: "Philosophy is not, as is sometimes said, a mere luxury; it is, under varying disguises, the daily bread of the whole world. Though the workers and speakers must always be few, those for whom they work and speak are many; and though the waves run highest in the centres of literary activity, the widening circles of philosophic thought reach in the end to the most distant shores. What is written in the study is soon preached from the pulpit, and discussed at the corners of the streets. There are materialists and idealists, positivists and mystics, evolutionists and specialists, in the work-shops as well as in the lecture-rooms; nay, the intellectual vigour and moral health of a nation depend no more on the established religion than on the dominant philosophy of the realm. No one, who watches the state of the intellectual atmosphere of Europe at the present moment, can fail to see that it is far more disturbed by philosophical than by theological questions,

and that the Darwinian creed, with all its consequences, does not concern scientific interests only; it reaches to the very foundations of religion and morality, and it must become, to every man who can honestly reason out its consequences, a question of life and death, in the deepest sense of the word. Strongly as I disapprove of mixing up scientific with religious questions, strongly as I deprecate any attempt at raising theological prejudice against the progress of free inquiry, I cannot help feeling that it would be paying a sorry compliment to scientific research, if, whatever its discoveries might be, it was never to be allowed to influence the deepest convictions of our soul. It makes a great difference to us whether we live in the atmosphere of Europe or of Africa; it makes the same difference whether we live in a century of Materialism or Idealism. In the great battle which has been going on since the first dawn of philosophy between Materialism and Idealism, the army fighting under the banner of Materialism is at present carrying everything before it. Materialism (I use the word in its widest but purely philosophic sense, not as a term of reproach) is everywhere in the ascendant; while Idealism has almost become a term of reproach. Far be it from me to envy Materialism its triumphs, or to make it responsible for the mischiefs it may cause. We do not blame thunderstorms in nature; and we ought to know that neither the complaints of the moralist nor the threats of the theologian will avail anything against the tempestuous progress of materialistic thought. Nay, it is perfectly true that the human mind stands in need of such tempests, in order to gain freshness and vigour; and the Idealist, however distressed at times, knows well enough that since the days of Plato his good ship has hitherto ridden out every gale."

The lecturer considered it a cause of real regret that so little attention is paid, in the controversies now carried on, to the

history of philosophy. Even if it were too much to require a knowledge of the whole history of philosophy, no one ought to approach the problems of Materialism and Idealism who was not familiar at least with the works of Locke, Berkley, Hume, and more particularly of Kant. Kant's position in philosophy was described more in detail, and his "Criticism of Pure Reason" was said to stand in the onward stream of philosophy like the rocks of Niagara. Kant was neither Materialist nor Idealist; his chief object was to determine, once for all, the organs and limits of our knowledge. He showed that our knowledge cannot be accounted for by outward and inward sensations only, and that Locke's treatment of the mind as a *tabula rasa*, receiving and digesting impressions we know not how, was pure metaphor. But even Locke admitted that the power of abstracting and forming general conceptions out of single impressions was peculiar to man, and "that it puts a perfect distinction betwixt man and brutes, being an excellency which the faculties of brutes do by no means attain to." Only one excuse could be imagined why Mr. Darwin and his followers should have disregarded the important conclusion arrived at on this point by former philosophers. They might say with some show of reason, "Why should we discuss the question of the constituent elements of the human mind? Why should we trouble ourselves whether Locke or Berkley or Hume was right in his analysis of mental faculties? We possess evidence which they did not possess, and which renders all their lucubrations unnecessary. We know that animals derive their knowledge through the senses only; we know also that man is the lineal or lateral descendant of some lower animal; therefore the human mind cannot be either more or less than a development of the animal mind."

The lecturer then proceeded to examine Mr. Darwin's

remarks on language more in detail. He criticised the idea of development as opposed to all sound reasoning. He objected to the constant recurring hypotheses of insensible gradation which would carry us back to the philosophy of Herakleitos, and in answer to Mr. Darwin's assertion, that, in a series of forms insensibly graduating from the same ape-like creature to man as he now is, it would be impossible to fix on any definite point where the term man ought to be used. He maintained that that point would be coincident with the radical period of language, with the first formation of general ideas embodied in the so-called roots of language. Different views of the origin of language were discussed, and it was shown that even those who believed in the *bow-wow* and *pooh-pooh* theories, in no way supported Mr. Darwin's view. Even if the materials of language were supplied by interjectional and imitative sounds, these materials would not account for language such as it is. One might say that the materials of the flints were found by thousands in the fields; but what we want to know is how flints came to have a shape and a purpose. To say that no traces of human workmanship can be discovered in these flints, or that there is no insuperable objection to the belief that they were fashioned by apes, would be absurd, but not half so absurd as to maintain that, the materials of language being given, everything else was a mere question of development, or might be the work of some ape-like creatures. In answer to Mr. Darwin and Archbishop Whateley, who ascribe language to animals as well as to men, Professor Max Müller entered fully on the distinction between emotional and rational language, claiming the former for men and animals, the latter for men only. Referring to the researches of M. Broca, Dr. Hughlings Jackson, Dr. Bateman, and others, he showed that the broad difference between these two modes of language

was clearly indicated by the convolutions of the brain, in their healthy and diseased state. Rational language is the work of reason, because every word in it is founded on an abstraction or general conception. Even such concrete words as *stable*, *saddle*, *road*, *father*, *mother*, are all in their origin abstract terms, and to believe with Mr. Darwin that there are savages who have no abstract terms, would be a mistake. All real words are derived from roots, and every root embodies a general or abstract conception. *Stable* comes from a root *stha*, to stand; *saddle*, from a root *sad*, to sit; *father*, from a root *pa*, to protect; *mother*, from a root *ma*, to fashion. This fact is the greatest discovery of the science of language. In that science the roots which remain as the constituent elements of all human speech are treated as ultimate facts, but in the science of thought they admit of a complete analysis. The lecturer then gave an explanation of the origin of roots. The imitation of the sounds, he said, by which our own feelings manifest themselves, and the imitation of the so-called sounds of nature,— for instance, the singing of birds, the howling of the wind, the falling of a stone, the crying of a child, the laughing of a friend or a fiend,—is by no means an easy group, and from the very beginning it must have given rise to an infinite variety of imitations, many of which it would be almost impossible to recognise without some other help. Not one of these imitations is to be taken for a root. How much these imitations vary we may see even in our own time, and among civilised nations, when we watch, for instance, their different modes of expressing surprise or admiration. Martinez, in his Spanish Grammar, tells us that ah ! ay ! and o ! express grief, joy, anger, and surprise. Ciconio ascribes to the Italian interjection ah ! and aha ! more than twenty significations. The Chinese *hu* and *fu* express surprise; *teal*,

applause; *i*, misery; *ai*, contempt; *uhu*, pain. The Frenchman, as an observant traveller has remarked, expresses surprise by *ah!* the Englishman by *oh!* the German by *ih!* The Frenchman says, "Ah! c'est à merveille;" the Englishman, "Oh! that is capital;" the German, "Ih! das ist ja prächtig." The divergence and uncertainty become still greater when we examine the way in which the sounds uttered by animals are imitated in different languages. I shall give a few specimens from Chinese only. What would you think to be the meaning of *kiao-kiao?* It is meant for the cry of the cock; *kao-kao* stands for the cry of the wild goose; *siao-siao* stands for the sound of wind and rain; *lin-lin* for the rolling of carriages; *tsaing-tsaing* for the sound of chains; *can-can* for the beating of drums, and so on. It would be easy to produce similar words from other languages in order to show, first, how difficult and fanciful all imitations of inarticulate by means of articulate sounds must be; secondly, how, after all, every one of these imitations can represent something very special only. One might imagine the possibility of a language consisting altogether of such imitative sounds; but, as a matter of fact, no tribe even of the lowest savages has been discovered employing no more than such utterances. The question therefore is, How does human language emerge from these purely animal, or at least half-animal, utterances? How, if we start from such imitations and interjections, as the incontestible materials of speech, can we ever arrive at the real elements of human languages — I mean the roots, the residue of our own scientific analysis? The question is not so difficult when we treat it in general; but it hardly admits of exact and scholarlike treatment when we approach it in detail. Interjections and imitations are the very opposite of roots; they are vague and varying in sound, but very special in meaning; while roots are very specific in sound, but general in their

meaning. There is the problem which has to be solved, and it can be solved only by a constant reference to the psychological process by which single impressions are changed into more general or abstract forms of thought. As soon as a general conception arose in the human mind, as soon as only two single impressions were combined, the imitative sounds of the one or the other, so far from being helpful, become hurtful and impossible. I shall try to make this clear by a very simple case. As long as people thought of sheep as sheep, and of cows as cows, they might very well indicate the former by the imitative sound of *baa*, the latter by the imitative sound of *moo*. But now suppose that for the first time the want was felt of speaking of a flock of sheep and cows, you will see that neither *baa* nor *moo* would do. They would be the very sounds to be avoided. What was wanted was either a combination of the two, or a compromise between the two. With the addition of every new element, and every new imitative sound, the difficulty became greater. It was easy enough to imitate the cries of the cuckoo and the cock, and the sounds "*cuckoo*" and "*cock*" might well be used as the phonetic signs of these two birds; but if a phonetic sign was required for the singing of more birds, or it may be of all possible birds, every imitation of a special note became useless, and nothing but a filing down of the sharp corners of these imitative sounds could answer the new purpose. This phonetic process, of what I call despecialising, runs exactly parallel with the process of the generalisation of our impressions, and through this process alone we are able to understand how, after a long struggle, the uncertain imitations of special impressions became the definite representations of general conceptions. In this way the origin of roots becomes perfectly intelligible in its general character, but in detail it almost withdraws itself from scientific observation. In this chaotic

process there is ample room for guessing, but it is almost impossible to prove anything, at least to the satisfaction of a scholarlike conscience. There may have been many imitations of the falling of rain, stones, trees, men, but in the root PAT they are all combined; nothing is left in it to remind us of the sound of falling rain, rather than of falling stones, and thus only could this root become the sign of every possible kind of falling, giving us not only the Sanskrit *patati*, the Greek *piptó*, the Latin *peto*, but likewise the Latin *impetus*, the Greek *potmos*—what falls, accident, fate—nay, our own feather and pen. There may, nay there must have been, innumerable imitations of the sounds of breaking, crushing, crashing, smashing, gnashing, dashing, splashing, but in the end we find them all tuned down in the Aryan family to a very simple root, "*mar*," of which I have very fully treated in one of my lectures on the Science of Language. If we can thus understand the necessary process of the despecialising of imitative sounds, and the gradual elaboration of roots, we shall also see that roots of a more general meaning must have proved the most useful, must have been used most frequently, and must thus have supplanted parallel roots of a more special meaning. There were from the beginning different degrees of generality of meaning in these roots; all did not reach the highest point, or the *summum genus*, but at times they became popular on account of their retaining a more special colouring. Again, in this struggle for generalisation, many roots must have crossed each other, and the general meanings of going, moving, sounding, falling must have been reached from very different starting points. Thus we can understand how, though beginning with the same materials, families, villages, tribes, and races would, after a very short separation, if it took place during the Radical Period, have become of necessity mutually unintelligible; so that the

most different families of language could have sprung from one common source. From this point of view, to deny the possibility of a common origin of language is simply absurd. Another question which has frequently been asked, viz., whether what are commonly called secondary and tertiary roots were derived from primary roots, or whether they are remnants of earlier stages in the development of language, does not admit of an equally conclusive answer. If we find three roots like *sar*, *sarp*, and *sarg*, expressive of different kinds of movement, we have a right to look upon the additional letters *p* and *g* as modificatory elements, and upon the roots formed by them as derived and secondary. This is particularly the case when these additional letters are used systematically — as, for instance, in forming causative, desiderative, inchoative, and intensive roots. But there are other cases where we must admit parallel roots representing to us independent attempts at fixing general conceptions. If one root was possible, other roots, too, were possible, very similar in sound and meaning, yet formed independently, and not simply derived. This mode of explaining existing varieties, not by genealogical succession but by collateral development, has of late been far too much neglected, not only in the science of language, but likewise in many branches of natural science. After what I have said, it will, I hope, have become clear to those who may have read my Lectures on the Science of Language, that what I called roots, or phonetic types, are indeed the ultimate facts in our analysis of language, but that from a higher and philosophical point of view, they admit of a perfectly intelligible explanation. They represent the nuclei formed in the chaos of interjectional and imitative sounds, the fixed centres which become settled in the vortex of natural selection. With these phonetic types, and not with the cries of animals, or the interjections of men, begins the history

of rational, as opposed to emotional language. Show me one root in the language of animals, and I shall say, with Mr. Darwin, that the faculty of articulate speech in itself does not offer any insuperable objection to the belief that man has been developed from some lower animal. One persuasive sentence from the note of a nightingale, one gruff remonstrance from the throat of a gorilla, would be sufficient to convince me that they are men in the truest sense of the word. An eminent German Professor, and he a Darwinian, declared that if a pig were to say, "I am a pig," it would, *ipso facto*, cease to be a pig. No doubt it would; but until it does, I hold to what I said twelve years ago, in my lectures on the Science of Language — and I hold to it with a conviction, strengthened only by the attacks that have been made upon it — that language is the true barrier between man and beast.

In the course of his lecture, which was listened to with earnest attention, Professor Müller was frequently applauded.

Dr. Nevins moved a vote of thanks to Professor Müller, and said it was a just source of congratulation to the Society that their course of Roscoe lectures had been inaugurated by one so interesting as that to which they had just listened. It was, he said, difficult to say whether its literary charms or philosophical feeling had been its most distinguishing feature.

Mr. J. A. Picton, in seconding the motion, said he was proud to find that the first lecture of the Roscoe series had fully answered, and more than answered, their highest expectations. He wished just to say a word as to the object they had in founding these lectures. They felt that in Liverpool there had been a great want of high class lectures. Of popular lectures they had had perhaps enough, and more than enough, not that for one moment he wished to depreciate them, because he believed that whatever called

our minds from the sordid concerns of the day, and led them to think, was an improvement, and a relaxation, and deserved to be encouraged; but they felt there was something required beyond this, and it occurred to them, as the oldest Literary Society in the town, that it would be possible to establish a series of Annual Lectures, to which they should invite the highest intellects in the country to instruct them in the subjects of the highest class which could engage their attention. He thought that they would all feel that their course had been fully justified by what they had heard. The subject which Professor Müller had treated was engaging the most intense consideration and anxiety, and the men who could lead in the proper course of thought, and could direct their minds to a satisfactory solution of this point, were rendering a noble service to their day and generation. Such, he believed they were all agreed, had been the case with the Address they had just heard. Professor Müller stood very high, perhaps at the summit of reputation, in regard to the particular class of subjects to which he had directed his attention. His reputation was not merely English, it was European, and perhaps many of them would know that, since the rehabilitation of the University of Strasburg, he had been invited there, and had taken a very active part in the reorganisation of that Institution, and he believed strenuous efforts were being made to get him to transfer his services from England to Germany. Professor Müller had a kind of divided nationality. He was a German by birth, yet his heart was in England. He had been domiciled in England many years, and had become so acclimatised and accustomed to England, that it would be very difficult to tell to which side his leanings were inclined. He (Mr. Picton) was, however, happy to say that they would still retain his services in England, although he might occasionally pay a visit to the other side.

The CHAIRMAN put the motion to the Meeting, and it was carried by acclamation.

The proceedings then terminated.

FIFTH ORDINARY MEETING.

ROYAL INSTITUTION, 16th December, 1872.

ALBERT JULIUS MOTT, PRESIDENT, in the Chair.

The PRESIDENT called attention to Mr. Lockyer's Paper in the current number of "*Nature*," on the Meteorology of the Future, in which the theory was advanced of a close connection between the changes in the solar spots and the variations of weather on the earth.

The Rev. W. KENNEDY-MOORE, M.A., read a short communication on Professor Max Müller's Lecture on Darwin's Philosophy of Language. The paper led to a discussion, in which Messrs. Picton, Birch, and Russell took part.

Mr. H. H. STATHAM, jun., then read a Paper on "Landscape Painting in English Poetry." *

SIXTH ORDINARY MEETING.

ROYAL INSTITUTION, 13th January, 1873.

ALBERT JULIUS MOTT, PRESIDENT, in the Chair.

The PRESIDENT read the following short Paper on the Duty of Scientific Men with regard to Spiritualism :—

"Without invoking a discussion on so awkward a subject as the so-called 'Spiritualism' of the present day, it will,

* See page 123.

I think, be right that I should say something in reference to the correspondence which has just appeared in the *Times*, on the duty of scientific men in relation to this question. My object is, if possible, to put the matter in its proper light so far as it may concern ourselves. The *Times*, on the 26th December, published an article, in which the writer described his personal experience at several of those meetings to which the name of '*séances*' has been given. He tried in vain to find evidence of imposture, or any other rational explanation of what he saw and heard; and he gives it as his opinion that, in regard to this subject, 'our scientific men have failed to do their duty by the public, which looks to them for its facts.' This article has called forth fourteen letters, only four of which are anonymous. The writers include Mr. Dircks, Mr. Serjeant Cox, and Mr. Alfred Wallace. The two latter make most remarkable statements, concerning facts within their own knowledge, and, with the exception of Mr. Dircks, there is a general agreement in the opinion that men of science are bound to examine the alleged phenomena, and to set at rest the question of their cause. Now, what is our real duty, as students of Nature and seekers after truth, under these circumstances? I think, myself, our duty is plain. As knights of the round table of science, we cannot refuse the challenge given to us. We are bound to investigate, however disagreeable the quest may be. The line to be drawn in matters of this kind seems to me tolerably clear. Life is short, and time is precious; and it is not our business to waste our days in listening to the fancies, and exposing the delusions, of people who can show no claim to our attention. But when men who are known to be credible witnesses in other affairs depose to facts within their own experience, the claim to attention is at once established. If the facts are new, they ought to be examined; if they are extraordinary, they ought to be fully explained

To turn our backs upon the direct testimony of rational observers, whatever may be its nature, is to cut the very ground from under our feet; for science rests solely on the observation of reasonable men; and to doubt its value upon one subject is to cast uncertainty upon all. Now, the plain fact is, that the statements made within the last fortnight in the *Times* leave us only a choice between two alternatives—either there is a power in nature with which science is unacquainted, or else there is a method of deceiving the senses which is equally unknown. In either case we cannot be content with anything less than a full discovery of the truth. A new power is of course only a new field for scientific interest, and nothing can be more important to us than to know exactly to what extent and by what means our senses can be deceived. Consider the nature of the deception, supposing we accept that theory. Mr. Alfred Wallace is one of the true paladins of modern discovery; Mr. Serjeant Cox is an expert in the examination of evidence; Mr. Crookes is an accomplished master of physical science. These men have made public declarations as to their own personal experience. They agree about the nature of the facts, the impossibility of fraud under the precautions taken, and the failure of all explanations which do not assume the existence of a new power. What is to be the fate of science if such men can be deceived under such circumstances, and if we are still unable to say how the deception is accomplished? When Mr. Serjeant Cox says that he has seen heavy weights moved through the air; when he himself has ascertained, and has had full means of ascertaining, that they were not moved by physical agency perceptible to touch or sight; what is our condition with regard to evidence if we can neither believe his statement nor show him the cause of his mistake? We are surely bound for our own sakes to do one or the other; and when men of this kind say, further,

that they themselves are surprised and bewildered, and that they desire the help of others in further investigation, there would be a want of good fellowship in refusing to give it, which, happily, is very rare in the scientific world. Having said thus much, however, I must guard myself against being misunderstood. I have myself an absolute belief in the reality of spiritual, as distinguished from material existence; but a total disbelief in the theory of spiritual agency, in the phenomena in question. This or any other theory may, of course, be used hypothetically for purposes of experiment, so long as we can treat it simply as a mere tentative hypothesis; but the acceptance of it as an ascertained truth on the existing evidence seems to me only a proof of intellectual credulity. And this brings us to the greatest difficulty with which the matter is beset. The world is full of foolish people, who seize on everything new and wonderful, and use it according to their own fancies, without reference to the requirements of scientific truth. And the world is also full of charlatans, who live upon the follies of this class. Between the two, any new facts of a mysterious kind are quickly imitated, and the imitations are credulously believed in. The truth becomes confounded with false representation and irrational theory, and men of science turn away, hastily perhaps, but naturally, from the uninviting theme. What we have to do, however, is not to give way to this natural feeling, but to keep clear from the follies that produce it. Especially we should avoid the unconscious imitation of them by the use of unsound reasoning on our own side. When Mr. Dircks objected that the alleged phenomena were opposed to the law of gravitation, he only laid himself open to a conclusive reply. The same must be said when the want of utility in what is learnt or done is urged against the evidence. It is a sound reason for not accepting most of the theories; no reason at all for not believing the

facts. An electrical machine was a toy in our younger days, and there is no particular use in knowing that a will-'o-the-wisp is not the lantern of a fairy. Nor must we object to dark rooms in making experiments. They increase our difficulties; but no man of science can be afraid of the dark. And if the facts are believed, we do not explain them by speaking generally of unconscious cerebration, or involuntary movement, or psychic force. If I call Pepper's ghost an optical illusion, what I say is true, but it is no explanation. The explanation consists in pointing out the actual method by which the eye can be so deceived, and the real reason for the deception. Questions of this kind should, I think, be approached with less timidity and more self-sacrifice. We all wish to appear wise in our generation; and there is nothing that a scientific man dreads more, or, in fact, has more reason to dread, than the risk of making a fool of himself. But in this we ought to help one another; and no one ought to be laughed at or condemned for any bold and honest endeavour to discover the truth on any subject. I am not prepared, in the present state of the case, to advise societies like our own to deal with Spiritualism collectively, but individually we ought, I think, to feel that a conclusive investigation of it must be made, and that when opportunity offers we are ready to help in making it. I myself have never yet attended a *séance*. I have no doubt it would try my patience greatly. The general conditions of the inquiry are simply of the most harassing kind imaginable to one who wishes only to know the truth. But science only recognises difficulties in order to overcome them, and Nature reserves her greatest secrets for the eyes of the bravest men."

Mr. Isaac Roberts exhibited a geological diagram of a section in the excavations made in Whitechapel for the erection of a new warehouse, and showed some specimens of the horn of an ox, portions of tree trunks, branches and roots,

found therein. He gave the following communication concerning the section : —

There were 8½ feet of rubbish filled in so as to raise the general surface of the land in the locality; then 1½ to 3 feet of vegetable soil, which formed the surface of the land before buildings were erected upon it, about a century ago. The roots of a shrub, and several small roots, were found in this bed.

Below this vegetable soil were 4 feet of blue clay, with a few thin bands of vegetable matter mixed through its mass.

A copper coin was also found, but it was so far decomposed that no trace of any inscription or stamp remained upon it.

Below the blue clay referred to, is a bed 3½ feet in thickness, containing about 32¾ per cent. of vegetable matter.

Beneath this vegetable bed, are 6 inches of coarse blueish silt, with a few rootlets penetrating it. Then there are 2 feet of blue sand, with sub-angular pebbles, and nodules of blue clay, under which lies the boulder clay, at the depth of 20 feet below the present level of Whitechapel, or about eight feet above the level of the Old Dock Sill.

The deepest part of the hollow is about 30 feet to the westward of Whitechapel.

Mr. Roberts said that a copy made of Leland's map of Liverpool, dated 1539, showed that the pool extended from the river Mersey for some distance along, and to the north of where Whitechapel now is; and that a *sluice* existed, probably to prevent the tides from overflowing the low land in this locality. The existence of such a sluice would enable us to account for the presence of the lower of the vegetable beds referred to, which is only 11 feet above the level of the Old Dock Sill, without having recourse to the convenient theory of a subsidence of the land since the vegetation grew.

Mr. T. J. Moore exhibited some rare specimens of

sponges and corallines, from Port Elizabeth and Western Australia, recently added to the Free Public Museum. Also some very beautiful specimens, cut and polished, of Carboniferous Corals, etc., from Bristol, from the Mendips, and the Mountain Limestone Rocks in South Wales, forming part of a very large and valuable series, recently presented to the Museum by Swinfen Jordan, Esq., of Clifton, and formerly of Liverpool.

Dr. Inman then gave an Address on "The Influence of Water in producing Scenic Phenomena," illustrated by a large number of water-colour sketches and other diagrams.*

SEVENTH ORDINARY MEETING.

Royal Institution, 27th January, 1873.

ALBERT JULIUS MOTT, President, in the Chair.

Mr. Alfred Higginson read the following communication on the Meteor Shower on the 27th November last :—

"On Wednesday, November 27th, at seven p.m., I heard that falling stars were abundant. My informant had counted about fifty in a walk of fifteen or twenty minutes. I looked out at the front and back of my house (north and south aspects), and saw them in pretty equal numbers on all sides, all descending from the zenith, which at that time was near the constellation Cassiopeia. At a later hour, about nine o'clock, on St. James's Mount, I had a more panoramic and clear view, the sky being nearly free from clouds. Cassiopeia was overhead, and the meteors of brightest aspect; if not originating in that region, they described tracks which would all meet nearly in that constellation, if traced upwards. All spread in falling, towards the horizon, like the ribs of an

* See page 215.

umbrella, and were (roughly estimated) as numerous and brilliant in one part of the heavens as in another. Some finished their course with a decided *flash* of light, and others left a trail of illumination in their path. Many were first seen at 25° or 30° from the zenith, and some of those most completely overhead did not reach to many degrees from the zenith. In the region of Cassiopeia I saw flashes of light without a visible meteoric ball. Again, there were faint meteors which traversed a very small apparent space, increasing rapidly in splendour, and ending only a few degrees from the spot whence they started into sight. The hue varied somewhat from a clear white light to a pink tint. I heard no noise from those which seemed the most explosive. The constellation Leo, from which the usual November meteors have been observed to emanate, was below the horizon during the whole time of observation."

The Rev. H. H. Higgins referred, in feeling and complimentary terms, to the scientific attainments of Professor Sedgwick, whose death had occurred that morning, at the age of eighty-five.

The President also referred to the recent demise of Mr. S. R. Graves, M.P. for Liverpool, and one of the members of the Society.

Dr. Inman showed a bun, of peculiar oval shape, which he connected with some ancient beliefs, associated with the worship of Baal.

Mr. T. Higgin brought under the notice of the Society some remarkable minute spines, which he had lately observed by microscopic examination of the carapace and limbs of a young specimen of one of the Stalk-eyed Crustaceans common on our coasts, known as *Hyas coartatus*, and made the following communication:—

"Professor Bell, in his description of this crab, makes no ·n of these spines, and it is surprising, if he were aware

of their existence, that he should not have mentioned this remarkable feature in the Crustaceans of this family. In his description of *Pisa tetraodon* (one of the same family), he alludes to the fact, that these slow-moving crabs are found covered with fuci, frequently so much so that the animal is quite concealed; and states that the plants found on them have taken root, during a period of inactivity, in the villous coating of the carapace and limbs. He alludes to the suggestion which had been made by Mr. Say, in the *Journal of the Academy of Science*, of Philadelphia, that these marine plants had probably been mechanically entangled by hooked hairs, to say that there can be no doubt that they are actually growing on the crab, and are attached by roots, as is evident from the healthy state of the plants.

"The specimens I have had under examination were taken in Carnarvon Bay, in the summer of 1871, whilst dredging for Zoophytes, and have been in dilute spirits of wine since that time.

"When taken out a short time ago, I found that the Algæ had become tender, and with care I was able to remove the greater part of them. I then observed that the whole of the carapace and limbs was studded with spines, some hooked, others straight, but bristling for about half their length with short hairs standing out at right angles to the spine. I noticed no indication of the plants being attached by roots, but there was a fragment of *Serialaria lendigera* lying along the carapace held down by the hooks.

"It appears that Mr. Say suspected the existence of these spines, and Professor Bell concluded that the plants were attached by roots because they appeared in a healthy state.

"It is quite clear, that this crab, studded with hooks as it is, could not possibly move about amongst the Algæ and Zoophytes without tearing off, and carrying away with it, portions of them.

"I have examined the specimens of this family which are in this Institution, and find that although most of the spines have been swept away in the process of cleaning, every specimen still carries some of the hooked spines."

Mr. ISAAC ROBERTS noticed the absence of skeletons of our domestic animals in our Museums, and suggested that the Society should impress upon the authorities of these institutions in Liverpool the desirability of obtaining such specimens. Mr. T. J. Moore stated that skeletons of the otter, badger, seal, hare, in fact, most of the wild animals of Britain, are already in the Free Museum. The Rev. H. H. Higgins pointed out the difficulty of obtaining series of skeletons of our domestic animals, owing to their varieties of breeding.

Messrs. H. H. Bremner and Julius Levis were duly elected ordinary members.

The Rev. THOS. P. KIRKMAN then read the second part of a Paper on "Philosophy without Assumptions."*

EIGHTH ORDINARY MEETING.

ROYAL INSTITUTION, February 10th, 1873.

ALBERT JULIUS MOTT, PRESIDENT, in the Chair.

Mr. RICHARD C. JOHNSON, Hon. Treasurer, exhibited a plan drawn on the blackboard, showing the positions of the Sun, Earth, and Mars, with respect to Biela's Comet, on the 14th September and 27th November last, to illustrate the connexion between the orbit of the Comet and the path of the Meteoric shower of November last.

Captain J. A. PERRY, associate of the Society, exhibited two living specimens of the Diamond Beetle from Brazil, which he believed were the first ever introduced into Europe.

* See page 88.

Mr. Joseph Boult then read a Paper on "The Mersey as known to the Romans."*

NINTH ORDINARY MEETING.

Royal Institution, February 24th, 1873.

ALBERT JULIUS MOTT, President, in the Chair.

The President called attention to the experiments now being made by Dr. Roberts, of Manchester, which he said did not confirm Dr. Bastian's speculations and experiments on the generation of Bacteria. Messrs. Higgins, Picton, Davies, and Fletcher also made some observations on the same subject.

Mr. T. J. Moore exhibited one of two fine specimens of Wyville Thomson's Encrinite (*Pentacrinus Wyville-Thomsonii* of J. G. Jeffreys) lately obtained for the Free Museum. These specimens, with a very few others, were obtained in the deep sea dredgings of H.M.S. "Porcupine," and were got in July, 1870, from a depth of seven hundred and ninety-five fathoms (nearly a mile), off the coast of Lisbon. The capture of these specimens was one of the chief events in the history of these dredgings, the species being quite new to science, and of high importance both in a zoological and geological point of view; two West Indian species being the only living representatives previously known of this nearly extinct group of Echinoderms.

The Rev. H. H. Higgins made some interesting observations on the relationship of these creatures.

Mr. T. J. Moore announced the capture of a living Seal, which was found on the Mersey shore at Frodsham Marsh, on the 3rd of February, and which is now being exhibited at Widnes, near Warrington. The seal is large and powerful,

* See page 249.

being about six feet in length, and in very fine condition, though it has taken but little food. The face, breast, and fore flippers are of a blackish colour, the body paler, with a few dark blotches; but the colours are not very noticeable while the creature is wet. From the dilatation of the nostrils, shown under the least provocation, Mr. Moore was inclined to consider it a Hooded Seal (*Cystophora*); but consideration of the extremely rare occurrence of that genus on the British coast withheld him from speaking positively.

Mr. E. Jones, B.A., then read a Paper on "Early English Pronunciation, with special reference to Shakespeare."

TENTH ORDINARY MEETING.

Royal Institution, 10th March, 1878.

ALBERT JULIUS MOTT, President, in the Chair.

Among those present were Mr. Pope Hennessey, late Governor of Sierra Leone, and Mr. J. M. Price, formerly colonial engineer of Sierra Leone, now promoted to be surveyor general at Hong Kong. Both these gentlemen were introduced by Mr. Moore, the Curator of the Free Public Museum, and they met with a very hearty reception.

The Chairman announced that the next Roscoe Lecture would be delivered in the ensuing autumn, by Dr. Carpenter.

Mr. Moore exhibited a rare British Sponge (*Isodictya varians*), and then said that Governor Pope Hennessey had on the previous day brought with him to Liverpool a young hippopotamus, of a very rare species. Judging by its dimensions, he believed that Mr. Hennessey had either made a mistake in calling the creature a hippopotamus, or had brought over a great novelty. Its total length was only two feet, and it weighed twenty-three pounds, whereas

the length of the one born in London was four feet two inches, and its weight ninety-nine pounds. Mr. Hennessey had kindly allowed the little creature (brought from the Great Scarcies River, West Africa) to be photographed by Messrs. Vandyke and Brown, of Bold Street, while the animal itself was to be presented to the Royal Zoological Gardens of Dublin. The creature had been successfully photographed in various positions, and after it was taken back to the Royal Hotel, where Mr. Price is staying, and bathed, it was thought that it would scarcely be prudent to bring the animal out again; otherwise it would have been exhibited before the Society. It was a Liberian or pigmy hippopotamus (*Hippopotamus liberiensis* of Morton). Previously to 1844 only one living species of hippopotamus was known to naturalists. In that year an entirely new kind was made known to science by the late Professor G. S. Morton, of Philadelphia, from two skulls presented to him by Dr. Goheen, who had resided for many years as colonial physician at Monrovia. So far as he (Mr. Moore) had yet been able to ascertain, up to the present time, no specimen or remains exist in England, or indeed in Europe; and it was doubtful if any remains but the skeleton had been received in America. Under these circumstances, the importation of a living young one was of very considerable interest. The following particulars, supplied to Professor Morton, probably comprise all that is yet known of this diminutive species, the skull of which is only half the length of the ordinary kind:—"Dr. Goheen, who assured me from the first that he could find no notice of this animal in the systematic works, has obligingly favoured me with the following memorandum in relation to it:—This animal abounds in the river St. Paul, and varies in weight from four hundred to seven hundred pounds. They are slow and heavy in their movements, yet will sometimes stray two

or three miles from the river, in which situation they are killed by the natives. They are extremely tenacious of life, and almost invulnerable, excepting when shot or otherwise wounded in the heart. When injured, they become irritable and dangerous, but are said by the natives never to attack them when in their canoes. The negroes are very fond of the flesh, which seems to be intermediate in flavour between beef and veal."

Governor HENNESSEY, in reply to the Chairman, said he was indebted to Mr. Price for the very interesting little animal. Mr. Price, who with himself was employed officially on the West Coast of Africa, obtained it from a Mandingo trader on the coast of Sierra Leone, and it was kept a little time at the Government House, in Sierra Leone. Mr. Price thought it was about six weeks old. In presenting it to the Zoological Society of Dublin, he felt that Liverpool, if it had had a zoological garden of its own, would have been entitled to the first chance, and, as there were two or three hippopotami in London, he thought he might safely send it on to Dublin. Yesterday he telegraphed to the secretary of the Dublin Society, and Dr. Haughton had replied to the effect that one of the keepers of the garden was coming across for the animal, and he was expected to arrive that evening. At all events, the first photographs of the creature, and the first dimensions, had been taken and given in Liverpool, and he heartily thanked Mr. Moore for the interesting account he had given of it, which had taught him more than he knew before of its extreme rarity. It was a great pleasure to Mr. Price and himself to have had the pleasure of meeting that learned society.

The PRESIDENT asked if it would be convenient for the young hippopotamus to be seen before leaving Liverpool; and upon the offer of suitable accommodation by Mr. Moore, it was agreed that the animal should be exhibited at the

Free Museum, to the members of the society, the next day, from ten to twelve o'clock.

Governor HENNESSEY stated that he had occasionally used the dredge while on the West African Coast, and had brought home some living specimens of shells (*Neritina intermedia*) from the falls of the Grea Scarcies River, north of Sierra Leone, a few of which he exhibited to the meeting, and should be happy to contribute to the Free Museum.

Captain JOHN A. PERRY, an Associate of the Society, exhibited a very ingenious device which he had worked out for sending messages by sea. At present, if a vessel founders, or is burnt while at sea, or comes in contact with ice and is lost, the only means by which the intelligence is made known is by placing a communication in a corked bottle, and throwing it into the sea. In a great number of cases there is every reason to suppose that these messages are never picked up, owing to the bottles being washed against rocks and upon shore, and broken, or from some other unfortunate circumstance, and thus the survivors of those who go down in vessels are left in doubt as to the cause of their untimely end. The device consists of a circular buoy, made of india-rubber, the bottom of which is in the shape of a peg-top, while upon the top a flag can be securely fastened, provided there is time, after a vessel has met with an accident, before she goes to the bottom. The name of the vessel is painted on the buoy, and fastened to the top are pieces of thin metal, upon which are printed such words as "ice," "collision," "fire," "foundering," and so on. Supposing the vessel should be seriously damaged by an iceberg, all that the officer in charge would have to do would be to double up the piece of metal on which the word "ice" appears, and throw it into the sea, in the full assurance that sooner or later it must be picked up. If time permitted, a written communication could be placed in a cylinder which is

fixed inside the buoy, and the flag already mentioned could then be screwed into the aperture.

The PRESIDENT said it was a most ingenious device, simple, and yet complete in its whole arrangements, and it was all the more valuable from the fact of its having been made by a sailor who knew the value of time, and could consider what had to be done in such emergencies as he had alluded to. It appeared admirably to answer the purpose for which it was intended.

Dr. HAYWARD exhibited a living Cobra da Capello, which had been brought from Calcutta.

Dr. NEVINS reported a very curious case of a flour mill having blown up spontaneously, and said that Dr. Campbell Brown proposed, at the next meeting, to bring forward the subject of explosions in flour mills, with experimental illustrations, and also to give some very curious and interesting matters relating to the question, which would be well worthy of philosophical inspection. The same gentleman also proposed to bring forward some illustrations of the so-called new gas for illuminating purposes.

Mr. C. E. RAWLINS announced that Dr. Ihne, late a member and ex-President of the Society, had been appointed to the chair for English Literature and Language and Roman Law in the Heidelberg University. This was the first instance of any German university appointing such a chair, and he proposed that the congratulations of the Society should be presented to Dr. Ihne on the event.

Dr. NEVINS, in seconding the motion, said that no one could read Dr. Ihne's papers on Roman law and character without deriving great pleasure therefrom.

The PRESIDENT, in putting the motion, which was unanimously agreed to, said that it was most gratifying to find that a late member of that Society, and an ex-President, had been selected to fill so high an honour.

The Paper for the evening was on "The Jury System," and was read by Mr. RUSSELL H. W. BIGGS.

ELEVENTH ORDINARY MEETING.

ROYAL INSTITUTION, March 24th, 1873.

ALBERT JULIUS MOTT, PRESIDENT, in the Chair.

Mr. T. J. MOORE exhibited a stuffed specimen of the Aye-Aye from Madagascar, and gave some details of its habits and structure.

Mr. MOORE also exhibited some disarticulated skulls, very finely mounted by Mr. E. Gerrard, Jun., of London, to facilitate the study of the various elements entering into the structure of the skull in the sheep, the turtle, the serpent, and codfish.*

Dr. MILLEN COUGHTREY communicated a note on the Tracheal Pouch of the Emu, a dissected specimen of which was exhibited.†

Dr. BROWN read a communication on the Cause of Explosions in Flour Mills,‡ and on the so-called New Gas, which he illustrated with experiments.

TWELFTH ORDINARY MEETING.

ROYAL INSTITUTION, April 7th, 1873.

ALBERT JULIUS MOTT, PRESIDENT, in the Chair.

The PRESIDENT exhibited a rain gauge for the use of ships at sea, to be introduced to the Cunard service. He

* See page 279. † See page 297. ‡ See page 301.

also referred to the remains of human workmanship alleged to be of the Miocene period found near the Straits of Dardanelles, by Mr. Calvert; the bone of a mastodon being found in a bed of drift on the Asiatic coast of the above Straits, with the figure of an animal deeply engraved on it.

Mr. Picton exhibited a Chinese treatise on Perspective, probably printed and published by the Jesuit missionaries in China. He also exhibited several maps as specimens, which were attempted to be palmed off on the public for authentic records of Old Liverpool. One is entitled "A Historical Map of Lyrpole from a very curious plan, originally in the possession of Mr. Leland, the antiquarian, A.D. 1539, with the fortifications as they appeared at the time of the siege, 1644;" copied from the original map by J. Butler, 1862; sold by A. Bowker, 17, Stanley Street, Dale Street. This production is an impudent forgery. The whole arrangement of the town is, on the face of it, absurd and impossible. The pretence of copying it from an original document is most discreditable to its authors. Another has recently been issued from the same source, giving a map of "Lerpoole, 1572." This map was originally inserted in Lacey's pictorial Liverpool, published in 1844. There is no reference to the map in the text, and its insertion was, there is reason to believe, objected to by the gentleman who edited the work. This map, though not so internally absurd as the former, is equally delusive. No authority is given, the plate being altogether spurious and misleading. The third plan is entitled, "A Plan of Liverpool and the Pool, as they appeared about the year 1650; copied from the original drawing deposited in the Court of the Duchy of Lancaster, and from other authentic and original documents, for *The Stranger in Liverpool.* Published by Thomas Kaye, 1829." This map was, Mr. Picton believed, compiled from various sources, by Mr. Charles Okill, at that

time clerk of committees to the Corporation, and may be relied on as generally correct. It has not, however, the authority of an original document, for which it is frequently mistaken. The first authentic map of Liverpool is that by J. Chadwick, 1725, entitled, "The mapp of all the streets, lanes, and alleys within the town of Liverpool, with one side of the River Mersey; layd down by a scale of eighty yards in an inch." There is a small map in the Binns' collection, in the Free Public Library, dated 1720; but there are some doubts as to its authenticity. Within the last twenty years, a map was issued purporting to be "Liverpool, as it was in the year 1725; from the original plan, by John Eyes." This has been taken from Eyes's original survey; but alterations have been made which destroy its authority as a contemporary document. The same liberty has been taken with views of the town. In Herdman's *Ancient Liverpool*, plate 2, vol. i., purports to be the earliest view of Liverpool known. It is stated to be "a representation of a part of the town in the thirteenth century, but by some it has been dated as far back as 1160." In this precious view, the Church of St. Nicholas is represented as it stood in the early part of the eighteenth century, before the spire was added. A row of cottages is shown on the shore in the style of the nineteenth century, and a house is visible behind the church, not unlike some of the recent villas at Waterloo. The whole representation is a grotesque anachronism. Spurious charters have also been brought out from time to time. Enfield, in his *History of Liverpool*, mentions one by Henry I. in 1129, and another is given in full by Troughton, ascribed to Henry II. in 1173. Both of these are entirely imaginary, the latter a clumsy fabrication. These particulars are mentioned to show the caution necessary to be exercised in dealing with our early history. The obligation and importance of truth and authenticity in dealing with historical questions is quite of

modern growth, but is daily more and more acknowledged in all inquiries of this kind.

Dr. Coughtrey exhibited the heart of an Emu, and read a Paper in which he compared certain of its peculiarities with the heart of man and of an elephant.*

Dr. Carter referred to the question of the new gas, and the possibility of rendering hydrogen luminous. After some conversation on this subject,

Dr. Inman read the Paper for the evening—"Remarks on certain ancient Temples in Malta"—which was followed by the usual discussion.

THIRTEENTH ORDINARY MEETING.

Royal Institution, April 21st, 1873.

ALBERT JULIUS MOTT, President, in the Chair.

Ladies were invited to the Meeting.

As this was the last Meeting of the Session, the President delivered the following concluding Address.

"This is the last Meeting of the present Session, and I shall take the opportunity of thanking the Society for the manner in which the duties of the President and the Council have been lightened by the assistance of the members generally.

"All our Meetings have been well attended; we have had a good supply of Papers, many interesting discussions, and much valuable information in the miscellaneous communications; and the whole business of the Session has been transacted in an excellent spirit, such as befits the Society and the age.

"I hope we shall go to our summer holiday, bearing in

* See page 327

mind that the value of the next Session will depend very much upon the use we make of the intermediate time; and that, in preparing Papers, we shall have the best reason to be satisfied with our work if we begin it at once, at least in the collection and arrangement of materials.

"A small matter well thought out is better than a large one undigested. Each member is generally the best judge as to his own pursuits; but I will suggest a few matters that seem especially interesting to myself, in the hope that some of us will find opportunities for investigating them.

"In Geology, the further discovery of mammalian remains in the older strata would be a matter of vast importance. The *à priori* reasons for thinking that the search for them must be vain have been greatly weakened. To find them, however, except by accident, we must consider where they should be looked for, and this is clearly in fluviatile or lacustrine deposits, or in marine beds close to some ancient shore. To detect any deposits of this kind is to open a new field to work in. We have Wales, Cumberland, and a long coast line within easy reach. The coal beds are promising strata. They must represent coast lines, though of a special kind. There are reports of mammalian discoveries in the carboniferous strata of Northumberland.

"Thermo-electricity is a tempting study. We do not yet know whether a useful electric engine can be made. There is enormous waste in using heat directly as a motive power. We use it as a repellent force. Muscular power, which is far more economical, is probably an attractive force. It is obtained at low temperatures, while our heat engines require high temperatures. A great number of small attractions, at very short distances, may amount to a considerable power working through a larger space. Thermo-electricity depends on differences of temperature, and we can always get one temperature for nothing. Experiments on this subject are

almost sure to be of value, whatever their result, and some of them can be tried best in summer, when the sun's heat is most available. Great questions of physics as well as of machinery are involved, and one at least of our members has already made some important observations in this field.

"Volcanic action is probably much the same now as a hundred, or a hundred thousand, years ago. But we hear of it more frequently and more quickly. A knowledge of its true causes, and, as a step towards this, any evidence that would determine whether it is a declining or a persistent energy, would be of the highest value to physical science. Mr. Mallet's new theory on the subject has been pronounced by high authority the only scientific explanation hitherto given. But I think this judgment is premature, for the explanation itself depends on several hypotheses, each of which is as purely speculative as the nebular theory. Those among us who have correspondents abroad would do very good service if they took every possible opportunity of getting immediate accounts of volcanic action from good eye-witnesses. What we want is not picturesque reports, but correct details. Volcanoes, doubtless, tell the story of the earth's crust, if we can read the writing.

"The August meteors will arrive before our next Meeting. The relation between comets and meteorites remains undetermined, and is not made clear by the identity of the orbits of some of them. If the solar system is crossed by long ellipses of meteoric matter, it seems not unlikely that bodies so light as comets may get entangled in them, and carried along with them. The fact that, at certain intervals, we gather up these really planetary bodies from space, suggests the question whether planets may gather their satellites or suns their planets in some analogous way.

"Our place among the stars has totally changed even during the ascertained human period, and the wildest conjec-

tures may fall far short of the truth in guessing what systems we have passed through during that prodigious journey. Every meteor shower should certainly be watched with care, especially for any new phenomena.

"The nature of Smell has a special interest in connection with inquiries concerning animal instincts and vegetable structure. We assume too readily that it depends on the diffusion of material particles. New experiments as to its relations with the atmosphere, the media through which it is transmitted, the rate and distance of transmission, the possibility of concentrating diffused odours, or of detecting them by any chemical or mechanical test, are well worth trying. The ear and the eye each makes us acquainted with a separate medium by which external facts became known. This may be true also of the nose. And among the instincts or mental operations of animals, those of insects will, doubtless, repay the devotion of many years. These are especially summer subjects, when every field is fragrant, and the air is full of wings, bearing lives as countless as the sands, each on its individual errand.

"There are recent accounts of cave explorations in Borneo, and of lake dwellings in some neighbouring islands. It is of equal interest to remember that the Pacific islands abound with ruins and sculptured stones, of which scarcely anything is known. We ought, in Liverpool, to find means for their examination.

"The inquiries I have suggested are all, you will observe, of a speculative kind. I choose them this evening on that account, as the most likely to suggest others as well.

"Scientific studies lose their interest as soon as they become simply practical or utilitarian.

"The pursuit of science leads us always between two dangers; the danger of wasting time by listening to foolish fancies, and the opposite and equal danger of arresting

thought by dogmatising upon the inferences to be drawn from accepted facts. The latter is at present the greater danger. We are beginning to assume a positive knowledge on many subjects which are, in fact, only in the first stages of investigation, and to set aside with something like intolerance whatever seems inconsistent with these assumptions. But true science demands an infinite patience, not only in our own enquiries, but in our treatment of the work of other men. All our knowledge is one-sided, and all our theories are in error, more or less. To the end of our days we can be but students only, not masters, in Nature's school; and the final objects of our study are not the facts we meet with, or the laws which regulate the facts, but the greater truths to which fact and law may lead us concerning their purpose and their cause. The human soul cannot content itself with an encyclopædia. It seeks a history and a prophecy, and it must continue to do so while man lives as he has hitherto done, looking before, and after.

"Lastly, as a Literary Society I think we pay too little attention to books themselves. It is not easy fully to recognise all that is done by the modern Press, or the rapidity with which all important work becomes embodied in thick volumes. We all feel, however, how difficult it is to read what we know is written and should be studied. An early and careful digest of an important book would sometimes be as valuable to us as an original Paper. We rarely get this in reviews, and it is work that can be well done by many who cannot devote themselves to practical science.

"I leave these suggestions in your hands. The present session has been distinguished by the delivery of our first Roscoe lecture. The second, by Dr. Carpenter, President of the British Association, is fixed for next October. I do not doubt that it will stimulate our interest in Philosophy, and

help to prepare us for whatever may be the discoveries of another year."

Mr. T. J. MOORE exhibited the following specimens recently added to the Free Public Museum.

A fine stuffed specimen of the gigantic stork-like bird, the Shoe-bill (*Balæniceps rex*, of Gould), so called from the enormous development of the beak, which bears a fanciful resemblance to an Arab shoe. The species was first described by Gould, in 1851, from a specimen brought by Mansfield Parkyns from the Upper Waters of the White Nile. Petherick subsequently met with the species at the Bahr-el-Gazal, and sent a couple of living specimens to the gardens of the Zoological Society of London, where they lived some time, and after death formed the subject of an elaborate memoir on their Osteology, published by Mr. W. K. Parker, in the *Transactions* of the Society; the conclusion of which is, that the *Balæniceps* is essentially a gigantic Heron, with varied relationships and modifications, the nearest and most important being to the comparatively diminutive Boat-bill (*Cancroma*) of South America.

Also a living Coleopterous Insect (*Deloyola crux*) presented by Mr. F. F. Cronin, by whom it was brought from the Elephanta Cave, Bombay. This beautiful beetle has the wing cases nearly transparent, except where covered with a cross of brilliant yellow colour, as bright as burnished gold.

Also, a series of specimens of Pearls from the Common Mussel (*Mytilus edulis*) both in their natural state, and as improved by artificial means by Mr. Robert Garner, F.L.S., Stoke-upon-Trent, who had kindly presented them to the Museum.

Also, a series of deep sea soundings and minute specimens from the Porcupine expeditions of 1869 and 1870, presented by Captain Inskip, R.N. In one of these samples

Mr. F. P. Marrat had found four species of Pteropods from nine hundred and ninety-four fathoms; and in others, Mr. T. Higgin had found two interesting sponges, one of which appeared to be the *Tisiphonia agariciformis*, figured in Wyville Thomson's delightful book, *The Depths of the Sea*, p. 74; and the other apparently identical with a sponge (*Tethya antarctica*) described by Carter in 1872, from specimens dredged by Captain Sir James Ross, in the Antarctic expedition of 1839–43. The Rev. W. H. Dallinger has kindly undertaken the examination of the Foraminifera of these soundings, forming the bulk of the series, and to communicate the results to the Society during the next Session, when also fuller details will be given of the above named, and other objects contained in Captain Inskip's most interesting donation.

Also, a remarkable instance of restoration of lost parts, as shown by the specimen of blind Crayfish (*Cambarus pellucidus*) brought from the Kentucky Caves, and presented by Mr. J. Frederick Bowman, of London, to the Museum Aquaria.* When received, November 16th, 1872, it had less than half the normal number of limbs; on the 17th of April, it cast its shell for the second time, and came out fully equipped with antennæ, claws, and legs, all complete, and of full size.

Also, an interesting sponge, collected in Carnarvon Bay by Mr. Thomas Higgin, and found by him to be the *Decirtus niger* of Carter, a black leathery species, seemingly synonymous with Bowerbank's *Hymeniacidon Bucklandi*.

Mr. Alfred Morgan then read a Paper on "Gems and Precious Stones."†

* See Report of the Meeting of the Society, November 18th, page xxxvi.

† See page 175.

PAPERS.

INAUGURAL ADDRESS.

By ALBERT J. MOTT.

The work of our Society, if compared with that of many kindred bodies, appears discursive and miscelluneous. We do not give ourselves to the systematic and exhaustive study of one or two special subjects. We do not arrange our Papers so that they may cover some field of inquiry marked out and limited for the inquirers; and our yearly volumes show nothing of that unity of purpose which we see in most scientific Transactions. This has often been brought against us as a reproach, but I venture to think we may be satisfied, and that, in our disregard of the ordinary canons of organisation, we not only carry out the Society's original purposes, but we do that which always needs to be done, and is especially needed at the present time.

The purposes of the Literary and Philosophical Society are indicated by its name, and their scope is clearly of the widest kind. For Literature includes all subjects on which books are written, and Philosophy is the summing up of human thought in the judgments of human wisdom. We could not, therefore, limit ourselves to particular subjects or modes of treatment, without abandoning the happy license which our name asserts for us; and, though this would be no reason against changing both name and method on sufficient grounds, there are, I think, considerations of the highest kind which should prevent us from doing so.

Science and Philosophy, Knowledge and Wisdom, though bound together by the closest ties, are not only distinct, but are in many ways dissimilar. Some knowledge is necessary to any wisdom, but the proportions in which the two may

coexist, differ in different cases to almost any degree. And while true wisdom is good in itself, whatever its origin, knowledge is neither good nor evil in itself, but is the necessary material out of which things, both good and evil, may be fashioned. It is the quarried stone and the felled timber, without which we can raise no temples here; but temples and prison-houses are built with the same timber and the same stone, and the world may be either the better or the worse for its possession. Now the present time is one of unexampled activity and success in the attainment of knowledge. We are learning every day new facts about the things around us, some of the most interesting among them being of a class which in our own boyhood even were supposed to be quite beyond the reach of human investigation. There is no present symptom of any stoppage in this course of acquirement. The latest discoveries are rather of new paths into new regions, than of the things we may expect to find there; and though there will of course come a time of exhaustion, when we shall find ourselves again on the shores of a boundless sea where there is no ship ready to carry us any farther, that period is not yet in sight. The pleasure of discovery is intense. The fascination of Science grows more powerful as the veils between ourselves and nature drop one by one. The beauty hidden in this world alone is so unutterably great, so inexhaustibly new, so varied and so wonderful, that the search after it, as soon as it is successful, is all absorbing, and the desire for knowledge soon becomes the passion of our lives. You will not suppose I have a word to say in disparagement of scientific study. We are all agreed, not only as to its value, but as to its real necessity for the true ends of life. To live without it is to sit with closed shutters where the sun is shining; to be content with poverty where palaces stand ready for us with open doors. But Science and Philosophy, like many things essential to

each other's welfare, are not always in perfect harmony on practical points; and the real present danger, the real tendency of modern intellectual labour, is that we should be satisfied with the heaping up of knowledge, especially of that received directly through the outward senses, or with shallow inferences from it, resulting from hasty thought; and should neglect as less interesting, and regard as less important, those views of our own true relation to whatever exists besides ourselves, which form the substance of philosophy. Great philosophers are not made by this or any other Society. They come among the strange erratic portents of new eras, over whose appearance we have no conscious power. But it is, I think, the office of our Society to encourage among its members a philosophic spirit, as distinguished from a purely scientific one; and we may do this by that very absence of concentration which enables us to discuss, and in this way to compare, a great variety of subjects, in the light of science, and with the aid of its methods of research, but with a wider object, dealing less with the details of knowledge and more with its results. With very little restriction, and this only of a precautionary kind, our evenings are open to the discussion of any subject really interesting to thoughtful men. We have, in consequence, among our members, representatives of every branch of learning; and on the questions considered here we get the views, not only of experts, but of intelligent outsiders, which, though of little value to science, are always of the highest interest to philosophy. Doubtless, we run some risk of encouraging shallowness instead of depth by this procedure, but it is our own fault if we do not escape this danger. To know everything about something, and something about everything, is a canon of study most admirable, where it can be applied. But it cannot always be applied, and if we are compelled to sacrifice one of its enactments, it is not always the truest wisdom to obey the

first. To know something about everything is of little worth, when the something known is of a superficial kind; but it may be of the highest value, if our knowledge concerns the general principles of many things, though we are unable to master their details. I repeat, therefore, that I think we may be satisfied. The office of more strictly scientific associations is as necessary and as honourable as our own; but we may recognise the fact of difference without any thought of rivalry, and continue our own course without doubting the wisdom of our founders.

In pursuance of this view, I shall ask you to-night to consider some remarks on the present state of philosophic thought, and then on its practical results in regard to our views of human life itself, as illustrated by the discussion concerning the antiquity of Man.

All scientific study leads irresistibly to an inquiry into the causes of natural phenomena.

Whatever our wish may be, we cannot, in fact, content ourselves by ascertaining the order in which events have succeeded each other in the past, and by forming the expectation that similar events will occur in similar order in the future. Why do we form this expectation? Is there anything to satisfy our reason, if we say that such a thing will happen, because a similar thing has happened? The very word "because" points out the answer to such a question. We cannot help distinguishing between causation and succession; and we cannot help attributing every event, not to an antecedent, but to a cause. This is true in every system of philosophy, even in those which deny the fact. For these only blend the idea of cause with that of succession, and present the complex notion as a simple one, by omitting to analyse it.

The usual form in which it is thus presented, is by attributing all events to the operation of Law; and in this form it appears to special advantage, because we are all agreed that Nature is governed in accordance with laws, which are definite and permanent. But then, what is Law, and what is it to be governed by it?

There are, I believe, three possible answers to this question, and they lead at once to the roots of all philosophies.

By Law, we may intend to denote simply the facts of experience and expectation, without attempting to account for them. We may say, All bodies that we have tried to lift have resisted our efforts. We expect that all other bodies will resist in like manner, if we try to lift them. Our expectation is fixed, and will not change; and when we say it is a law that all bodies are heavy, we intend simply to assert these facts.

This answer dispenses altogether with the idea of cause, but its unsatisfactory nature is plain upon the surface. Most of us would say at once, that what we mean by Law is something different. We do not merely mean that things have happened, and expectations have been formed. We mean that those expectations are justified; that we have not only had experience, but that it has taught us something; that the law of occurrence is not the same thing as the fact.

The second answer, recognising this objection, defines law, not merely as the order in which events have occurred and are expected, but as the order in which they are compelled to occur, and in which, therefore, there is a reason why they should be expected.

Here a new element comes into the definition. The idea of compulsion includes the idea of that which compels,

and Power, not succession, becomes the essential element of law. Now Law itself is continually used in the sense of power. We speak of Law, meaning not only the Order, but the Agent of compulsory change; and it is through this species of personification, whereby an active force and a definite order are blended together as parts of one great and all-pervading Cause, that we are able to think of law as a real explanation of phenomena, and to believe that we may rest on it as upon solid ground.

But it needs no difficult analysis to disclose the want of any real connecting link between force and order, when brought together in this way. Law is not the name of any existing thing; of any Being in whom force and order are natural elements, working in natural harmony. It is, on the contrary, one of those names which stand as substitutes for things; which carry with them the idea of an existence, not in fact existing, and are therefore the most formidable blinds that hang between ourselves and truth. The word Law, which is of the utmost service while it is the name of that which is to be done, becomes a hindrance of the first order the moment we use it to denote the doer. Conscious that every act must have an agent, we seem to have named the agent, and so accounted for the act, when we say it is the result of law, and we forget that we have created an imaginary being out of a verbal metaphor.

The third answer to the question, What is law? goes to the root of the matter. Causation is the exercise of Power, and Law is the order in which power is in fact exerted. And Power is not succession or antecedence, but something else. The best thinkers of our own age, and of every age, have arrived at this final answer, and have agreed substantially so far. But two opposite systems of philosophy spring from this common foundation, and the conflict between them

affects our whole view of life and nature, of things past and present and to come.

What is this something else which we call Power, and which we recognise as the cause of change?

The answer on the one hand is, that Power is an element of Life, and that, when power is exerted, there is therefore a living being who exerts it.

On the other hand, it is affirmed, that power is either a property of matter, or else of some other thing whose nature is unknown.

Now, the first answer contains nothing of which the real meaning is obscure. The terms Life, Power, Living Being, and the exertion of Power, all refer directly to our own immediate consciousness. We know perfectly what we mean by them with reference to ourselves. That it is not only difficult, but impossible, to explain them by any simpler words, is the necessary result of the fact that they are names of things of which we are actually conscious. Immediate consciousness is, of course, the foundation of all knowledge. It is to it that we appeal, in conveying our thoughts to others; and we can appeal to nothing beyond it. We are all conscious of the things we mean by Life and Power and Existence, just as we are of pain and pleasure, sight and hearing. The object of all definition is to express ourselves in unmistakable words; and this is completely accomplished when the words themselves refer directly to the consciousness of both speaker and hearer.

But the second answer, which asserts that power is a property of matter, or of something unknown, is very different in its nature. I will not discuss the question as to our immediate consciousness of matter, or the meaning of these words, but will ask you to consider only what is meant by the word Property.

It is a fact that the word property describes ultimately

that of which we are really conscious; but it is unfortunately the name of two very different things.

At the bottom of all our consciousness, lying there as the foundation of all we know, are the two Facts of Being and Doing. We know ourselves, and all other things appear to us, either as existing in certain modes, or acting in certain ways. We distinguish things external to ourselves sometimes by reference to what they are, sometimes to what they do. We use the word Property as a common name for That by which they are Distinguished; and we say that certain objects have certain properties, with the intention of describing either the mode of their existence, or the manner of their action. But Being and Doing have nothing else in common; and when we speak thus of the properties of things, it is essential that we should understand clearly to which class of facts we are referring.

Now when it is said that power of any kind is a property of matter, there is an evident commingling of two sets of ideas. We know that a material substance appears to do certain things, to move in certain ways. We call this its property, naming thereby merely the observed fact concerning its apparent action. But power means the cause of the action, not the act itself, and we do not know that the cause of the action is a property of the substance.

It is true, and it is certain, that the acts are done, that they have been done in an observed order, and that we expect that order to be continued. But the question is, how they are done, and on what ground we expect that order to be continued. If we find out their cause, and find also that it has a permanent existence, there is a solid reason for our expectation; but if we find nothing but the acts themselves to account for their occurrence and recurrence, where is our solid reason?

I see the fly-wheel of a steam engine moving round. To describe it intelligibly, as a fly-wheel, I must include the fact of its steady motion, which is thus spoken of as one of the properties of the wheel. The cause of this motion is the up and down movement of the piston, which, in the same sense, is a property of the piston. The piston moves on account of the expansive motion of the steam, which again is a property of the steam. The steam is made to expand by the heat-vibrations coming from the furnace, which are the property of a vibrating medium. The heat-vibration is set up by molecular motion in the fuel; the property of substances coming into chemical combination. The chemical combination is caused by the attraction of these bodies for each other, which is, we say, another property of the same substances.

Now in this analysis you will observe that, in every case except the last, the word property has reference to the manner in which acts are done; but in the last case, it has reference to the power by which they are done. That bodies have moved or are moving in certain ways, is a fact of observation; that there is a power which determines their motion in every case, is an unavoidable inference. When we say they attract each other, we only assert the existence of such a power, for which the word attraction is simply a convenient name. But acts are not powers, nor are powers acts; and the use of the word property to denote indiscriminately both of these things is, I think, one of the chief impediments to a proper understanding between science and philosophy.

When we use the word Property in the sense of Power, what is it that we are really speaking of? Can we describe it, or define it? You will find that we can only do this in one special way. Description and definition are simply the

comparison of the thing described with something else already known to us. If I wish to describe to you the face of a stranger, I do it by reminding you of some familiar face, and pointing out the likeness and the difference. But if I wish to describe a head-ache, how am I to do it? If I know that we have both felt pain of several kinds, and have similar recollections about it, I can describe my head-ache by comparison with some of these remembered pains. But otherwise it would be impossible to describe it.

Now power is like pain in this respect. We ourselves have it, and use it, and are conscious of its possession and its use; but we can only describe it by comparing it with something like itself. And as there is nothing like itself except its own varying forms, any description of power is a description of that which we ourselves are conscious of possessing. It is not, like external objects, or states, or acts, something of which we infer the existence from the facts of our own consciousness. We find it amongst those facts, and know it, not inferentially, but absolutely, as a necessary part of ourselves, without which we should not be ourselves.

Power is thus known to us as the Property of a Living Being, in a true and perfect sense, for it is one of the things by which a living being is definitely distinguished as such. But what else do we know about power, and what else are we speaking of when we attribute its possession to other things? We know absolutely nothing else. To say that any thing has power, is to say that it is like ourselves as living beings; and the reason why we are able to overlook this, and to think of power and life as separable, is a want of attention to the nature of our own experience, and to the grounds on which we infer the existence of any other power besides our own. This result is in no way evaded by the physical theory which regards our own consciousness of power as only the memory of muscular sensations; for in that case, what we mean by

power can be nothing but muscular sensation, and to attribute this to other objects is to treat them as if they were alive.

The real and only reasonable ground on which the idea of Law is founded I believe to be this: When we see anything done, we infer at once that there is some power which does it. When the same thing is done repeatedly, we infer that the same power repeats its acts. When it is regularly done under given circumstances, we infer that the acting power has a permanent existence, and that under those circumstances it exerts itself. An acting power means an existing actor. If an actor exists, who has regularly been known to do certain things under certain circumstances, it is reasonable to expect a repetition of the same things under the same circumstances; because it is circumstance that calls forth and determines action, as we know within ourselves.

Thus, the idea of law is always finally the idea of some existing actor, exerting power for some definite end. We think, indeed, of actors as inanimate objects, and disguise power under the name of property; but when we have done this, we find ourselves obliged to give back in metaphor what we have taken away in fact, and, having first got rid of personality by using the word law, we treat law itself as if it were a living person.

The distinction between acts and their causes, and the ultimate consequences of it, are well illustrated by the behaviour of a common magnet. A small piece of iron rests upon the ground. I hold a magnet over it, an inch above it, and nothing occurs that I am aware of. I bring the magnet down to within a quarter of an inch, and the piece of iron immediately springs upward to meet it. Now it does not spring upward merely because it is iron, for a larger piece will not move. And the latter does not lie still merely because it is heavy, for a piece of cork will do the same.

Again, if I gradually increase the size of the piece of iron, I find that the magnet must be moved nearer and nearer to it before it will rise, till I come to a point at which the disposition to rise seems exactly balanced by the disposition to lie still, and if at this point I put the iron in a scale, still holding the magnet over it, the iron would appear to have no weight in the scale.

What is the explanation of these phenomena ?

In the first place, the magnet on one side and the earth on the other appear to have the same relation to the piece of iron, but not to the piece of cork.

In the next place, what we really observe is not only that the iron and the cork act in certain ways, but that they have a tendency to act in these ways. The iron has a tendency to move towards the earth, and also to move towards the magnet; the amount of this tendency varies with the distance between the objects, and there is a conflict between the two tendencies. The cork, on the other hand, cares nothing for the magnet, but clings to the earth. The iron is equally indifferent to the cork, though not so to either the earth or the magnet.

What I wish to point out is, that the facts here described are exactly like the phenomena produced by the action of a living being, and are not like anything else with which we are equally well acquainted.

The desire for something; the effort to accomplish that desire; the power of making such an effort; the occurrence of many wishes, all of which cannot be gratified together; a conflict between them resulting either in specific action or balanced inactivity; inclination towards certain objects; indifference to others; these are the well known characteristics of what we call sentient life. That is to say, of life which in its essence is what we are conscious of in

ourselves. If we suppose the conduct of the earth, the magnet, the iron, and the cork to be a manifestation of life, it accords with that supposition, and there is no other hypothesis which really gives us the least real explanation of the facts observed. You know, of course, that modern theory falls back upon the supposition, that what we see in magnetism and gravitation is due in fact to the mere impact of invisible matter upon visible matter; but here the true question is only evaded. Apart from the important truth that there is no experimental proof, and that the kind of motion which could account for the phenomena has never been conceived, the whole kinetic doctrine is obliged to include the assumption that different substances differ in their moving effects, and in the manner in which these occur, and this difference, if closely pressed, leads to exactly the same evidence of an initial choice, acting through a static power, and determining an initial effort.

We are compelled at last to speak, not of motion, but of Tendency. Now Tendency is something of which we have an absolute knowledge. We have mental tendencies, and they are neither more nor less than conditions of the will. Choice, preference, wish ; these are the synonymes of tendency, and though the word, like most other words, refers literally to material objects in a certain state, it is that state precisely which implies the existence of a choice, and not of a motion.

Thus we come by every road to the conception of every change as the act of an existing actor, and the question, what is the nature of the actor, is the final question of philosophy. Is it, in the case of the visible universe, something unknown and unknowable, to which we give the name of force, only in despair of any better name, meaning when we use that word to assert our total ignorance of anything

but the fact that there is an unknown actor of some inconceivable kind? Or is it something of which we know the further fact, that as the possessor of will and power it is so far like ourselves? I shall not attempt here to argue this question, but shall make one suggestion in relation to it.

We ourselves have a certain power over material things. We are able to control their motion, and its results; and it is in our nature to exercise this control for definite and permanent purposes. Now if the universe has simply developed itself, in our case, into beings of this kind, there is every reason to expect that other beings of the same kind have also been developed. There is no reason to believe that our powers are the greatest possible, or that any extension of them which we can think of is impossible; and as there is no limit to the time during which development may have been going on, or to the material on which it may have operated, it is reasonable to expect that somewhere in the unlimited universe one or more beings would have been developed with powers equally unlimited. Such beings would use their powers, and would thus become, to an extent which we cannot measure, directors of the universe; even as we become its directors within the limits of our power. It follows therefore that, even supposing an unknown and lifeless Force to be in truth the origin of nature, the fact of our own existence as one of its products would still give us the strongest ground for believing that Intelligent Power, immeasurably greater than our own, lives, and reigns, and may be sought, and should be found.

I have been dealing with matters which belong to the region of Metaphysics, and there is a strong disposition at present to avoid all intercourse with that, in some parts, very shadowy realm. The intention is to get rid of useless speculation on questions which can be brought to no experi-

mental test; but the effect has been to fix attention upon one class of experiments, and to withdraw it from another. We receive impressions through the senses, and draw inferences from them concerning external objects, and physical science occupies itself in dealing with those inferences; but it is at least as important to consider the actual experience on which all inference depends. The examination of our own mental states is experimental science of the strictest kind; and it has this extraordinary advantage, that all its facts are certainties, if we take the trouble to ascertain them. When we receive impressions of sight, it is always possible to doubt the existence of an outward object; but the existence of the impressions cannot be doubted; it is a fact of absolute, not of inferential, knowledge. And what are these impressions? What are thought, and inference, and observation? What are human experience and human language? None of these questions can be answered, even superficially, without plunging into the very depths of metaphysics. Conscious of this, and aware of the profound difficulties which must be encountered in this field, many earnest students of science are anxious to separate their favourite studies from all inquiries of this kind, and to induce the scientific world to content itself with the observation of facts, and of the practical laws of their occurrence. But the attempt must always be in vain. It is is not a dead, but a living, universe that meets our eyes. There is no branch of science which does not lead ultimately to the study of that which is alive; and how can we, longing for life, and yet reminded everywhere of the shortness of our days, be indifferent to the very questions which are the first to arise when we consider the nature of any living thing? The difficulties must be met; they cannot be evaded. What is needed is not that the study of that which lies behind the inferences of the senses should be discarded as a vain pursuit, but

that it should be entered upon with greater vigour and exactitude, with a determination to understand what is to be understood, and at least to master in it that which lies at the foundation of all sound reasoning, the knowledge of what it is that we take for granted.

The irrepressible nature of the whole inquiry concerning life itself is very clearly shown by those reasonings upon the origin of man with which we are now familiar. Led by scientific research to the idea that what is complex must have a beginning in what is simple, and discarding for the time the equally demonstrable truth that what is simple must be taken from what is complex, modern science has hastened to the conclusion that whatever life is at present, it must have been simpler in the past; and, complexity in human life being considered synonymous with civilisation, the idea of a universal barbarism at some former period has seemed to be a necessary inference in the history of man. Certain facts in favour of this idea have been seized upon with a species of enthusiasm. Our pedigree has been traced, not to gods and heroes as of old, but to cave-men and cannibals; and a vast amount of information, most valuable and interesting in itself, has been already collected by Mr. Tylor, Sir John Lubbock, and others, about the thoughts and habits of savage tribes.

I cannot doubt that a more profound psychology would entirely change the nature of the discussion, and would put an end at once to a vast number of crude ideas; but instead of approaching the subject from the psychological side, I shall ask you to consider it as it stands affected by our present knowledge concerning the antiquity of the human race.

The old chronology has ceased to be defensible, and has to be laid aside altogether as either a mistake or a misunder-

standing. Between these two alternatives science has no means of determining, and, indeed, no interest in trying to do so; and those who feel any difficulty in the matter on theological grounds may remember that, as we in fact know very little about the mode of estimating time in very ancient days, nothing is more likely than that the reckoning should have been misunderstood.

That we have been wrong, however, is certain; and although a new chronology of the remote past cannot yet be constructed, it is at least not improbable that some of the remains of human workmanship already in our museums are a hundred thousand years old. There is not a single reason for supposing that these are the oldest we are likely to find. Most of them have been discovered only during the last fifteen years. They have been found only in special places, and the places themselves have become known by accident; and the present land above the sea, and the former land beneath it, remains unexamined except in these spots, which are in truth mere specks upon the surface. It is certainly a fact that no theory concerning the history of mankind can be worth much attention now, if it would be inconsistent with the existence of men upon the world a hundred thousand years ago.

Now the theory set up by anthropologists of the modern school is, that certainly men existed at that remote period, but that they were all savages, and that the history of our race has been that of gradual progress from a savage to a civilized state. This theory agrees with the general doctrine of evolution, and with the views of Mr. Darwin, and with the common interpretation of the geological record. It finds a natural place in that conception of the universe which represents everything as beginning in formless chaos, out of which a more and more perfect order has slowly been developing.

The question has, of course, been beset with theological difficulties, but these may all be laid aside. It is understood at last that, if natural forces produced the world and its inhabitants, something else produced the natural forces, and that any debate on this ground between science and theology can refer only to modes of procedure, and must leave untouched the question of their cause. I do not mean that no practical difference results from our theories on these subjects, but that, while we are dealing with them as theories, we may do so with perfect peace of mind, knowing beforehand that from their very nature they can never lead to anything by which theology is necessarily superseded.

Now on the question of fact, I shall say at once that the doctrine of an ancient world, peopled only by savages, seems to me a too hasty generalisation from evidence both insufficient in its nature and incorrect in its interpretation.

The sum of the evidence is as follows. Implements of flint and bone, such as are now made by savage tribes, are found on the surface of the ground, and in burial places, in most parts of the world. Similar implements, generally of a ruder kind, are found in many caverns, deeply imbedded with the bones of extinct animals; and in certain gravel beds, of equal or greater antiquity, they are also found, the forms being still ruder. Many bogs, shell mounds, and the remains of lake dwellings yield similar testimony; and through the whole series, there is an absence of metal among the earlier remains, while bronze and iron occur generally in succession afterwards.

These facts are indisputable; and, at first sight, the inference drawn from them appears equally so.

But we meet on reflection with one great preliminary difficulty. Suppose the world peopled only by the makers of these rudest tools. They were not beings of a lower nature than our own. The evidence before us points to

nothing materially different from human life as it is found at present among uncultivated tribes. How long can we believe that they could all remain in that primitive condition, and by what kind of process can we account for civilisation? Barbarism, so far as we know it, is not a condition of great and permanent stability; nor is the civilisation of a race of men a very slow and gradual process, when it occurs at all. To suppose that races who lived with the mammoth and the reindeer in the South of Europe, and who, in that severe climate, were skilful enough to make the flint tools of the river drift and the bone needles of the caves, and to carve the shapes of animals on horn and stone, could remain savages for perhaps a thousand centuries, and then develop into the conditions of civilisation, is at least very unlikely. Yet, this is the proposition involved in the modern theory; for, unless we know that the whole world was once barbaric, we cannot know that barbarism developed by itself into civilised life; and if there was a time when all men were savages, they must have continued so till the first civilised race was formed. And unless no such race was formed till comparatively recent times, there is no such proof of a universal barbarism as we have been pre-supposing. This is a real dilemma, out of which escape is difficult.

What kind of men are they who, with the whole world before them, could remain in a savage state through such vast periods of time, and yet possess and retain the qualities which enabled them, in more recent days, to civilise themselves?

So far as I am aware, no attempt has been made to answer this question, and it justifies us at all events in considering closely how far the modern doctrine is a necessary inference from the facts we know.

The first thing to notice is, that the theory rests almost entirely upon negative evidence. It is not the presence of

rude implements, but the absence of better ones; not the proof that there were savages, but the want of proof that there were civilised men in the far off ages of the world, that gives strength to the reasoning. If there was civilisation in those days, where are its remains? And why is it that, when we do find vestiges of human works, the oldest are the rudest? These are fair questions, but I think they can be answered without admitting the inference that has been drawn.

The works of man are, for the most part, as fragile as himself. They perish rapidly, and generally the most elaborate art is the least enduring. The most useful metals, iron especially, corrode and disappear, if exposed for centuries to air and water. In thickly populated countries, old works of almost every kind are constantly used up as materials for newer ones. The obliteration of the past is rapid, as the activity of the present is great; and if we look for antiquities, our best chance of finding them is always either in deserted lands, or in spots where, by some exceptional means, they were hidden before they were destroyed. And as the only permanent hiding place is in the ground, the only relics of very great age are objects that, by some means, have been buried where they could neither perish nor be disturbed. Accordingly, it is in caves under floors of stalagmite, and in ancient gravel beds, where they have been preserved like fossils, that the earliest remains of human workmanship have hitherto been found. But caves, at any period of the world, are not likely to have been the dwelling-places of civilised men, so that we cannot expect to find in them the relics of civilisation, and the nature of the river drift makes their presence in it equally improbable. For that drift has been formed either by the floods of swollen torrents, or the more gradual process of deposition at the bottom of rivers. Civilised men generally keep themselves out of the reach of inundation, and most objects of human workmanship dropped

into rivers have little chance of being permanently preserved, unless they are themselves almost indestructible.

Now flints, and siliceous stones generally, are among the most enduring substances known to us. Neither the rush of water, nor the fall of rocks, nor the grinding of pebbles, nor long exposure to air, moisture, or heat is sufficient to destroy them. They remain almost unchanged, where every trace of wood or metal would disappear, and there is, therefore, an inherent probability that, in our search for relics of the past, the oldest we are likely to find will be such as are made of these materials. And since they are the materials which have been used by savages much more generally than by civilised men, the history of savage life is what we must expect to find revealed by them. On the other hand, the entire absence of any remains of civilised life during these distant epochs would, if it were certain, be sufficient to sustain the modern theory; for, though flint hammers and chisels would remain unaltered, while the iron tools of an English carpenter rusted away, there are, of course, many objects that may exist for ages among the works of higher art and skill. Gold and jewels are too rare to be of much account, but glass and pottery are abundant; and pottery, at all events, is likely to have been so among any civilised races who may have existed since the reindeer period of Europe. But the question, Why do we not find such relics of ancient days? must be answered by two other questions. Where are we likely to find them? and where have we looked? Nothing of so great an age could remain preserved upon the surface, and we must therefore look for them under ground. What are their probable burial places, and to what extent have they been examined?

The inquiry leads at once to some very important considerations, most of which have, I think, been partially forgotten.

At present, three-fourths of all the people in the world are found in China, India, Europe, and the United States. The area of all these countries put together is only about one-fourth of the habitable land. The rest of the land is inhabited chiefly by savages, or semi-civilised tribes, the spots of civilisation upon it being at present small, both in area and population. The concentration of a large number of men within a small area is the necessary condition of progress in human art. Men cannot become skilful artificers unless they have time to acquire skill, and a strong reason for taking the trouble; and neither the time nor the reason can be found while they are thinly scattered. The earnings of England at the present day are probably as great as has ever been possible to any race of men; yet, they amount to only about twice as much as the average cost of the necessities of life. If the whole were equally divided, every family of five would have an income of about two pounds a week. There are perhaps four million families whose income is not more than one pound a week, and there is, in consequence, a surplus of four million pounds a week out of their average production. This surplus is the basis of all our material progress, nor is material progress possible on any other foundation. There is no wealth anywhere unless a large number of workers are living in the simplest way, while the extra product of their work is collected together; and there is no progress in human industry till wealth itself, and the hope of getting it, act together as the support and the reason for exertion. Where every man enjoys the whole fruit of his own labour, all men are of necessity very poor. They are also of necessity thinly scattered, and are in fact in the normal condition of savage life. It follows that all nations in which the arts have made that progress which we associate with the idea of civilised life, must always have been thickly peopled; and it follows from this that, unless the whole

population of the world has been very much larger than it is now, which is extremely unlikely, civilisation must always have been confined, as now, to a comparatively small portion of the habitable land. How small this portion really is we can hardly understand, unless we bring before our minds the vast spaces of country in even the most populous lands which are in fact unoccupied, or are only passed over now and then by human beings, who leave no trace whatever of their existence. When this is fully realised, we shall understand, in the first place, that remains of human workmanship are not to be looked for everywhere, even in the countries where they are most abundant, and most likely to be found.

There is geological proof of glacial action and biological evidence of an arctic climate as far south as the Mediterranean, within comparatively recent times. We know that man and the reindeer lived together not far from the Pyrenees. The immediate effect of this knowledge is to strike out the whole of Europe from those divisions of the world in which it would be natural to look for signs of ancient civilisation. Men cannot be numerous in frigid regions, and would not if they could; but our knowledge of man's antiquity is derived chiefly from European remains. It is from Kent cavern and the rocks of the Dordogne, from the valleys of the Ouse and the Somme, from objects found in Germany and Denmark, that we have got most of our information. The whole of this must be set aside, if we mean to judge the matter impartially. The ancient history of Europe must of course be the history of barbarism. Whatever may have been the sites of former civilisation since the last glacial period, it is not here that they can be found.

Nor is it possible, with our present information, to fix with any certainty on more likely places. We have to bear in mind that an area, much exceeding that of all the dry land in the world, lies at present under the Pacific ocean;

that there are other oceans also as large as continents; that land and sea are always changing places; and that we are quite unable to draw a chart of the earth as it existed a hundred thousand years ago. To infer from negative evidence that there were no civilised nations at that remote period, is to assume a knowledge of data which at present are totally beyond our reach.

There is, however, a general belief that civilised races can never pass into oblivion, but must hand down their own history, in writing or in tradition, to the remotest time. This belief is full of interest, but it rests, I think, mainly on that natural egotism by which we exaggerate our own importance, and forget that our successors, like ourselves, will be far more interested in the present and the future of their own lives than they can be with the past. The truth is, that the history of all civilised races goes back to a certain distance, and there ends in mythology. But mythology is not a description of savage life. It is not a tradition of something worse, but almost always of something better, than the matter of fact which follows it; yet it is not history. And even in what are called historical times, what do we really know about the old Egyptians, the Assyrians, the Persians, the Chinese before Confucius, the Hindoos before Alexander the Great? Our whole knowledge of the Aryan race begins with the Vedic hymns. But these are the hymns of a noble and cultivated people. Where is the history of their ancestors?

History, it must be remembered, is only preserved so long as it is interesting; and generally human beings have no interest in anything that happened several thousand years before their time. The love of antiquarian research is not a permanent passion in the human mind. It is probably entirely unknown to the great majority of men; and among those races and classes in which it breaks forth at times with

great intensity, the active causes are intermittent in their nature. Continued research requires the stimulus of successful discovery. When any particular field is exhausted, our interest flags, and at last expires, unless it is again excited by the opening up of regions hitherto unexplored. So that there have been, and doubtless always will be, long periods of quiescence in our relations with the past, and these become ultimately impassable gulfs in the stream of history, where, instead of friendly shores and guiding beacons, we come suddenly upon mist or darkness, or a stretch of mere blue distance, through which nothing is discerned. Nor does it seem likely that the invention of printing will make any great difference in the backward range of authentic history. No printed book will last for two thousand years; and when the books of any epoch have all perished, nothing will remain of their record, except what has been transferred to newer literature; and as newer literature only makes use of what is interesting at its own period, there is a perpetual winnowing away of the older story. When we add to this the changes which occur in every language and in every nation, the rapidity with which dialects become unintelligible, and the frequent transfer of the world's intellectual activity from one race to another, we shall, I think, find reason to believe that civilisation, as it now exists, will not prevent human history from being always limited in its retrospect, and, in consequence, that the loss of it in former times is no real proof of the absence of former civilisation.

But a still higher question is involved in the mere use of this word, civilisation. What do we mean by it? What is its value? And what facts are we looking for when we inquire into its history? Clearly the word refers to man himself, and not either to his works or his surroundings. It is his intellectual and moral being that we speak of,

and we call him civilised or not, according to the culture of his mind and the character of his behaviour. It is true that when we cannot see the men themselves, we judge them by their works, knowing that mental characteristics may be inferred from their physical manifestations, but it is most important to remember in what widely different forms a cultivated race may expend its energies. An English gentleman would not cease to be a civilised being if, lost among the deserts of the world, he had to dress in leaves, and feed upon berries; and there are thousands among ourselves, using and even making the delicate products of modern art, who are as rude and barbarous as a Patagonian. Mere differences of climate and locality, altering both the necessities and the pleasures of life, are sufficient to give perfectly distinct directions of human activity. Geographical and geological changes, affecting the relations between land and sea, the nature of the soil, the materials available for use, the distribution of empire, and the position of particular races, may vary the outward character of civilisation to almost any degree; and it must be rash and dangerous to infer, with any confidence, the real state of any ancient people from the works they have left behind, unless from these or other sources we really obtain a fair knowledge of the conditions under which they lived.

The difficulty in obtaining this knowledge from the evidence of human workmanship, in which it is not the most characteristic objects, but simply the most enduring, that get preserved, gives an additional value to every written record of pre-historic times; but it has justly been observed that, as writing is itself a proof of culture, such records must always leave the question of an earlier barbarism unsolved. This is true; but, on the other hand, the theory of a savage origin for the whole human race

requires evidence of a time when there was in fact no civilisation; and if, while the rude implements of a certain period prove that there were savages at that time in one part of the world, the remains of literature prove that there were civilised races in another part; the whole result is simply that the world was then, as now, partly savage and partly civilised.

Now there are no written records much older than the Vedic hymns. They take us back some four thousand years, or more, and the Sanskrit in which they were written is itself a proof of culture at a much earlier date. But this language can be traced down to certain roots which have acquired great theoretical importance. The roots are monosyllables, and it has been commonly assumed that when you have arrived at monosyllables you must be close upon the beginnings of human speech. I must, of course, speak with diffidence on such a subject, considering the high authorities who have given countenance to this view; yet I cannot for a moment believe that it is really tenable. On what ground do we suppose that the earliest form of speech would be monosyllabic? No savage nation at present speaks in this way. The nearest approach to a monosyllabic language is the Chinese, which is one of the most elaborately cultured. It is not a fact that children naturally speak only in monosyllables; or that these are necessarily the easiest forms of utterance. It is easier to say Johnny than John, Better than Best, Dunna than Don't. Nor, again, is it a fact that children and savages naturally speak alike, for children speak with organs not fully formed. And nothing can be more unlikely than that a language really invented by savages should be regular and uniform in the length of its words. If some were monosyllables, others would be different. Nor do any of the theories proposed, as to the origin of language, account for any such uniformity. The cries of animals and

the sounds of nature are by no means generally such as can be imitated by monosyllables. Nor are natural interjections all of this form. And as to a language supernaturally given to man, no one can suggest a reason why it should be thus limited in the length of its words. Any system of linguistic roots, which are all alike in their structure, must necessarily be an artificial system; the result of some long process by which some kind of language has been reduced to this particular uniformity; not the first instrument by which men gave natural utterance to all the diversity of thought and feeling.

This view is very strongly confirmed by the different structure of the Semitic roots. The formation here is as regular as in the Aryan tongues, but it is quite of another kind. Each verbal root consists essentially of three consonants, and is therefore in most cases unpronounceable as a monosyllable. There is nothing to show that either of these root systems is older than the other.

Now if the Semitic roots as well as the Aryan are in fact the substance of a really primeval language, there must have been two such languages to begin with, and any theory which accounts for one of them will not be applicable to the other; while if either of these root systems is not original, but derived, it proves at once that true roots can be formed out of some older language, and can become the positive basis of a new family of tongues. In either case, therefore, the existence of systematic roots throws us upon processes in the history of speech which must have occupied an enormous lapse of time, and the date at which a truly original language can give any proof of an original barbarism is pushed back indefinitely into the unknown past.

If the details of any process by which an existing language could be reduced to the form of roots are at present not understood, it does not seem difficult to comprehend the

general nature of the change itself, and of the causes that might produce it. The first effort of men in the use of speech is to make their thoughts fully understood by others, but when this is accomplished by a sufficient vocabulary, the next effort is to do the business quickly. Our time is short; our thoughts are far more rapid than our tongues. We necessarily try to abbreviate the forms of speech. The extent to which this can be done depends greatly on the structure of the language; on the character and influence of the literature; and on the causes which lead to the introduction of foreign words. For a language to become purely monosyllabic, the most favourable condition would seem to be a state of long isolation, during which little new would be added, while the old materials, thoroughly familiar and universally understood, would gradually be ground down to the simplest intelligible form. It is most remarkable that these very conditions have probably existed in China for an unknown length of time, and that we actually find there a monosyllabic tongue. We are hardly aware of the extent to which this is approached already by the English language. In the first five verses of Genesis, five words out of every six are monosyllables, twenty-two of these being consecutive. In the Lord's Prayer; in the speech beginning "All the world 's a stage;" in the first paragraph of Nicholas Nickleby, they are five out of every seven; and this is a common proportion in good English. It is easy to write English books in words of one syllable; and though these are children's books, this is because no single section of the language is sufficient for maturer thought, except in the shape of fragments. But a man may say, "I love you, now and to the end of time; with all my heart and mind; with all my soul and strength," and though every word is a monosyllable, he is using the language of full manhood, and expressing thoughts of extreme complexity.

The speakers of English are at present in the least favourable state for a systematic condensation of language, for they come into contact with all the world, and novelties, both in thought and speech, aro imported daily; yet we are constantly abbreviating words and condensing sentences. When an American says, "I 've been burgled"—where an Englishman would say, "My house has been broken into by thieves"—he succeeds in shortening the statement by more than half, and he invents a word, almost a monosyllable, which might easily become a root expressing the general idea of house-breaking. We do not like these changes, but we know they are inevitable; and no one, I think, could maintain successfully that the whole English tongue might not be reduced to a monosyllabic form, if sufficient time were allowed, and the circumstances were favourable. If, after this had happened, we became the conquerors of a weaker race speaking a different tongue, the probable result would be the formation of a new language, whose roots would be the monosyllables of English speech, while its actual words would be modifications of these into forms congenial with the mental and lingual habits of the conquered people. And in any such case, the words which became roots by natural selection would be those most easily understood, and therefore soonest adopted, and these would necessarily be words expressive of acts and objects perceived by the outward senses. For the purpose of speech is to make ourselves understood; and when there is any difficulty, as in the intercourse of different races, it is by reference to outward objects that our meaning must be explained. The general objective character of roots agrees with this, as does also the historical fact that most nations have been founded by conquest, and that most of the existing languages are the result of one form of speech acting upon and altering another. If the relation between more recent tongues and

those from which they are derived differs in some respects from that between the most ancient of known languages and its roots, this seems accountable for, first, by the mere lapse of time which has obliterated all traces of the origin of these roots; and, secondly, by the consideration that, although the secular changes in human speech are doubtless analogous in kind, they can never be twice the same in all particulars. But if the formation of languages as old as Sanskrit admits of any such explanation, our knowledge of philology suggests no limit to the antiquity of man. The process is one that may be repeated any number of times, each repetition involving probably a period of many thousand years.

The fact that the remains of savage customs can be traced in the manners and traditions of all civilised races has been much dwelt upon of late. But this is what we must naturally expect on any theory. Both civilisation and barbarism move from place to place, and necessarily come into contact with each other. Every portion of the earth has probably at one time or other been occupied by savages, who always leave a certain impression upon their civilised successors. Words, traditions, and habits derived from the Red Indians will be extant in America for ages to come; and if sufficient pains were taken, it is not unlikely that survivals of civilised thought might be discovered in the habits of all savage tribes. The custom of burning the dead, for example, might, in certain conditions of the world, be the result of the highest civilisation, adopting it on sanitary grounds; and it is perhaps as natural to find the origin of human sacrifice in the noblest acts of self-immolation, as in any purely savage ideas about life and the unseen powers of nature.

And savages themselves may be accounted for by a theory of degradation, whatever may be said by its opponents. There can be no question but that, if the most degraded of

our own race were separated from the rest, and thrown upon their own resources in some wild region by themselves, a savage tribe would be the result. And many causes may lead to such separations.

Nor are we to assume that there is no direct evidence of national degradation on a very large scale. There is abundant proof that America, from the Ohio to the Plate, was formerly inhabited by a very numerous people, far higher than the Indians. Numbers of the Pacific Islands contain evidence of a similar kind. Discoveries of immense buildings in the interior of Africa make the same course of events probable there. Egypt has its pyramids, bearing witness to a much greater past. The deserts of Syria were once peopled by the architects and sculptors of Nineveh. That is to say, in all parts of the earth beyond the reach of glacial action, there are widely spread evidences of higher races which have been succeeded by lower ones. And if these things are on the present dry land, what may not the sea have covered?

Moreover, it must be borne in mind that, in the decline of nations, whenever this is gradual, man himself destroys more rapidly than nature; and the relics he leaves at last are not those of his earlier greatness, but of his final decay.

Imagine England, sinking slowly into decrepitude. Her people in its first stages would cease to multiply their works, and would content themselves with using what was already in existence. As buildings fell into decay, and machinery failed, and was abandoned; as commerce died away, and ships lay useless, and docks and warehouses grew far too large, the languor of the time would begin to use the old materials for its daily wants; and when a scarcity of coal and iron and a dwindling traffic brought our railways to a stand, the increased difficulty of transit would hasten the local destruction. Empty mansions, silent theatres, and

ruined churches would not long be spared. The work of the nineteenth century would vanish day by day, and would be replaced by that of a lower civilisation. As population failed, one district after another would be at last deserted, and then the proofs of man's occupation would be converted into monuments; relics of an era past away, and a story ended, with which future antiquaries might busy themselves in a future age. But these relics would tell of England, not in her greatness, but in the last hours of her decay; and it might be inferred that we were a people no higher than the mound builders of the Mississippi, instead of being the civilisers of half the world.

When anything like an unlimited antiquity for the human race in its civilised form is suggested to biologists, one special difficulty occurs to them, on which I shall say a few words. The fact, that among animals generally no particular species can exist unchanged for an indefinite time, is pretty well established; and it is felt in consequence that if the human race is to be traced back into early geological times, the men of those days must have been specifically different from ourselves. Now I think we may admit this without being the least uneasy about it. What we call specific difference is a difference in bodily organisation. It is not a difference in vital purposes or vital powers. If we compare any fish from the paleozoic rocks with any that are now existing, we find important differences in their structure; but if we think of them as conscious beings, the perception of difference vanishes. So far as their bodily organs differ, their experience in the use of them will differ also; but it is in the living creature who feels, and not in the thing that happens to be felt, that we discern the true likeness of vital being. Now men themselves, as we know them, do differ very widely in bodily structure; and there is not the

least mental difficulty in thinking of a man, who would be neither more nor less than human, with almost any amount of bodily alteration. A man may lose his legs and his arms without any change of nature, and if he were born with neither arms nor legs it might be the same.

The nature we care about is our mental nature, and there is no necessary connexion whatever, as far as our real knowledge goes, between any power of mind and any bodily shape. A man is a being who has a man's powers and feelings; not a being who grows to a particular size, and has a certain number of bones. Birds are the best imitators of our speech; monkeys, of our movements; but insects probably of our mental operations. There is apparently hardly any approach among quadrupeds to the mental life of ants and other invertebrates; and all notions about the dependence of thought upon a spinal column, a formal brain, or a certain quantity of matter, are founded upon no evidence of any kind. We may admit therefore at once, that if there were men in very ancient days, there was probably some difference between their bodily form and ours; and we may be prepared to find their fossils, even with hoofs and tails, without prejudice to their true humanity. It is not by the shape they bore, but by the powers they were endowed with, that we must determine the condition of our ancestors.

If these suggestions are sound, the result may be summed up as follows:—

There is conclusive proof of the existence of men in the time of the mammoth and many other extinct animals; and in the period when the reindeer lived in the south of Europe. The earliest relics yet discovered are what we may suppose to have been the tools of savages. Their actual age cannot be ascertained at present, but a thousand centuries might very well be required for the geological and other changes

that are known to have occurred since these tools were made; and human history has no record whatever of any period approaching them in antiquity.

But there is nothing to show that the makers of these tools were the only races of men then existing. If the world was peopled then as it is now, partly by civilised and partly by savage tribes, there is no sufficient reason for believing that the evidence would be different. Flint implements have been preserved, because they are indestructible. They have been found, because from their indestructibility their number is immense, and because they have been naturally buried in gravel beds which are easily and often cut into, and in caverns, which attract our notice when their probable contents are known. They are found in all countries, because the distribution of savage and civilised life is continually changing; and the oldest are the rudest, because in the common order of events the less skilful tribes become displaced by the more skilful. When thus displaced, they either disappear, or are driven into regions which have become unoccupied, and in which barbaric life will begin again. Such regions will of course have had an earlier history; it may be of life in all its phases; but they must generally have been desolated by the greater changes in climate and in surface which take place very slowly, or by the gradual dying out of a failing race; and it is not surprising, therefore, if they contain few remaining traces of previous occupation, and none that will last so long as the rude stone implements of barbarism.

In this manner we may conceive that cycle after cycle of successive change may occur, in a world peopled as we find it now, without any essential difference in the character of its antiquarian remains. There will of course be periods of more or less activity; eras of great discoveries, which affect

the habits of whole races, perhaps of the whole world; ages of comparative stagnation, when nothing new is discovered, when the incitements to human effort are feeble, and arts are lost, and important truths forgotten, and a general languor ends in a general decay; and then ages of revival, when some obscure family or tribe wakes to a nobler life, finds itself among unused opportunities, becomes a nation and an empire, and begins another age of gold.

Such a view of human nature is in harmony with the highest teachings of geology, and of philosophy in its profoundest moods. For these assure us that the search after the true beginning of anything has hitherto been vain; that the present order of things has existed at least far beyond the reach of our present gaze; and that we are much more likely to find an explanation of the phenomena around us by assuming that the past has been like the present in all essential particulars, than by allowing our fancy to construct new conditions in order to account for what we see.

Certainly the belief that not only savages but men equal to ourselves have lived for unknown ages, through successive periods of geological time, gives at least a fresh nobility to all archeological pursuits. Instead of looking chiefly for ape-like forms and proofs of ignorant barbarity, we shall look for evidences of human greatness in the distant past, and shall begin to consider where we may hope to find them. It will hardly be in caves or gravel beds; nor shall we perhaps obtain the clue till some happy accident reveals it; but in the mean time it will be natural to turn to the sites of the oldest known civilisation, and learn what Egypt, India and China can disclose, concerning not the lower but the higher races of men. Pottery, which may be ten thousand years older than the Pyramids, has already been found

in the mud of the Nile; and effectual search in this direction has not yet begun.

I have used the great problem of the antiquity of man to illustrate the relation between science and philosophy, because science just now is busy upon matters bearing upon the nature, origin, and destinies of living beings. These are always the chief subjects of philosophic thought, and it is where our philosophy is doubtful, that our science is on these points most likely to lead us astray. Every man has a philosophy of his own on which he rests his reasonings, but the axioms of thought as they were understood fifty years ago have become to a great extent untenable. The philosophy of the future will, I have no doubt, differ from that of the past, much less in its results than in its processes; but the latter are being formed anew, and are still unformed, and we suffer in the interval. The proper lesson is one of patience and caution; an earnest interest in the acquisition of all knowledge, but a steady forbearance from hasty inferences, formed on limited experience, and unsupported by wider truths. The spirit of this forbearance is far more likely to arise from breadth of survey than from a more perfect but less comprehensive study of details, and it is in consequence the spirit we may hope to cultivate successfully in a Society like our own.

THE CHESHIRE SALT DISTRICT.

BY THOMAS WARD.

DURING the year 1871, there were exported from the Mersey 1,051,884 tons of salt. This large export was made up of 942,291 tons of manufactured white salt, and 109,593 tons of rock salt. The whole of this came from Cheshire. If we add 500,000 tons for the salt sent by rail, river, and canal to other parts of the country, we have a million and a half tons of salt supplied in 1871 by Cheshire.

It was distributed as follows:—

	White Salt.	Rock Salt.
Europe, including the British Islands, took	351,376¼	104,766¼
America	284,961¼	3,593½
Asia	273,191½	0
Africa	25,170¼	0
Australasia	7,592	1,233
Total ...	942,291¼	109,592¾

The salt trade has increased very considerably during the present century, especially that of white salt. In the year 1800 there was exported from the Mersey 142,475 tons of white salt, and 34,939 tons of rock salt, a total of 177,414 tons. Add to this 20,000 tons white salt, and 20,000 tons rock salt, sent out of the county otherwise than through the ports of the Mersey, — and the statistics of the period show these quantities to be quite sufficient, — and we have a gross total of 217,414 tons for the salt production of Cheshire for the year 1800.

Salt is very widely distributed over the earth; the British Islands possessing a large quantity in the following districts: Cheshire, by far the most important; Worcestershire, in the

neighbourhood of Droitwich and Stoke Prior; Carrickfergus, on Belfast Lough; and Middlesborough-on-Tees.

At Middlesborough, a very fine bed of rock salt has been discovered, and Messrs. Bolckow, Vaughan and Co. are sinking a shaft to work it. No brine has been found.

At Carrickfergus, a bed of rock salt was discovered some years ago, and is being worked by the Belfast Mining Company and Mr. Dalway, M.P. No brine has been found here.

At Droitwich and Stoke Prior, are copious brine springs, but no rock salt is worked, the head of brine being too great to allow the successful sinking of shafts. The rock salt underlies the brine.

In Cheshire, both rock salt and brine are met with.

If we take a map of Cheshire, we shall find, running through the middle of the county, the River Weaver. It is the most important stream in the county, for the Mersey merely runs along the boundary, and the Dee only drains one small corner. Considerably more than one-half of Cheshire is drained by the Weaver and its tributaries. Rising at the foot of the Peckforton Hills, the river pursues a generally south-east direction to Audlem, when it takes a northerly course as far as Northwich, then runs north-westerly to the Mersey at Frodsham. Its most important tributary is the Dane, which runs into it at Northwich. The Dane receives the Wheelock at Middlewich. At Northwich, besides the Dane, the Weaver is joined by Peover Brook, and one or two lesser streams. After leaving Northwich it receives no other important tributaries. The salt district of Cheshire lies in the valleys of the Weaver and Wheelock. Traces of brine have been perceived as near the source of the Weaver as Bickley and Baddiley; also at Brine Pits farm, between Audlem and Nantwich; but it is not till we reach the latter place that any important body of brine is met with. Nantwich does not manufacture salt in the present day. Originally it was the most important salt-

producing town in Cheshire; but, owing to brine being more plentiful and stronger at other places, and also owing to the Weaver not being navigable so high up, the salt trade of the town has decayed. It is strange how long a reputation will survive. Even now, Nantwich is spoken of by writers as *the* salt town of Cheshire; and not long since one of our most noted scientific periodicals inserted a notice of a landslip at Nantwich, instead of Northwich. This confusion of Nantwich with Northwich, and gross mistakes as to the nature of the salt formations, are far from uncommon; and Charles Kingsley, in his letters on geological subjects, in *Good Words*, has completely misrepresented the true state of the case. In *Good Words* for March, Kingsley writes:—"Those vast deposits of rock salt which have been long worked and worked to such good purpose, that a vast subsidence of land has just taken place near *Nantwich*, in Cheshire, and serious fears are entertained lest the town itself may subside, to fill up the caverns below, from whence the salt has been quarried."

The subsidence, firstly, was not near Nantwich; secondly, was not caused by the working of the rock salt; thirdly, did not cause fears to be entertained lest the town itself should subside, seeing that the subsidence was five miles from Northwich, further from Nantwich, and two miles from Winsford; and, lastly, rock salt is not quarried under the town of Northwich, though it is to a slight extent in Witton.

The next most important place in the Weaver valley is Winsford. Unlike Nantwich, which lives on a reputation of past glories, Winsford, decidedly the largest salt-producing place in Cheshire, very rarely gets credit for its enormous production. It is so little known as not to appear in some of our best general gazetteers. It is not a large town, but rather a number of villages, each retaining its own name. Winsford is the name of the district as far as salt is concerned. Over and Wharton are included in it. North-

wich, the largest and best known of the salt towns of England, lies at the junction of the Dane and Weaver, and is composed of Northwich proper, Leftwich, Winnington, Castle Northwich, and Witton, the last the largest portion of the town. It is noted for its mines of rock salt, as well as its white salt works, and is the real centre of the salt trade, and a flourishing town.

Between Northwich and the mouth of the Weaver, if we except Winnington and Anderton, near to Northwich, and generally reckoned with it, there are no other salt towns, though here and there traces of brine have been met with.

The Weaver is a very pretty river, and a sail from Weston Point on the Mersey to Winsford Bridge would reveal beauties of scenery scarcely to be expected along a river, the traffic on which is unequalled for its size in the British islands. From Northwich to the immediate neighbourhood of the Winsford salt works, near Newbridge, the scenery is charming, the latter portion being the famous Vale Royal.

The valley of the Wheelock is the second important salt district of Cheshire. Middlewich, at the junction of the Dane and Wheelock, is an old salt town, but, something like Nantwich, its reputation is greater than its desert.

Wheelock and Sandbach, and the immediate neighbourhood, are the most important salt centres of the Wheelock valley, though, compared with those of the Weaver, they are comparatively insignificant.

In October, 1872, the number of pans employed in the manufacture of salt were, at

Middlewich	.. ...	...	13 pans.
Wheelock and neighbourhood		...	61 "
Northwich	do.	...	386 "
Winsford	do.	...	556 "

In the Wheelock valley no rock salt mines are worked. At Winsford one mine only is worked, although three or

four have been sunk in the district. At Northwich there are ten or eleven mines in work, and a large number out of work or worked out.

The present working salt district of Cheshire is included within a triangle, having Marston (about a mile to the north of Northwich), Over (in the immediate neighbourhood and a little to the west of Winsford), and Roughwood (a short distance to the east of Wheelock) as the angular points. The area of this triangle is about twenty-six square miles. Out of this twenty-six square miles, not five are really occupied by salt works or mines.

At Winsford the salt works lie on both sides of the river Weaver, from a short distance south of Winsford Bridge to Newbridge, a mile and a half in a direct line, or about two miles along the curves of the stream. The salt works are principally situated on the flat, low-lying land, but, on the east side or right bank of the river, on the neighbouring high ground also. The river runs in a narrow valley for the whole of the distance from Winsford to Northwich, bordered on each side, in the neighbourhood of Winsford, by high and steep clay hills. The whole of this district is supposed to have rock salt underneath. How far the salt extends in any direction is unknown, as very few shafts have been sunk out of the immediate neighbourhood of the Weaver. About two miles to the west of Winsford, in the neighbourhood of Marton Hall, a recent extensive sinking and falling in of the land seems to indicate the existence of rock salt and brine in that neighbourhood. Again, up the valley of the Weaver, southward of Winsford Bridge, the land sinks very much, and extensive pools of water, from a few feet to forty feet in depth, about a mile long, and varying from a few yards to several hundred in breadth, are met with, known locally by the name of *Flashes*. These show that rock salt and brine exist in the Weaver valley for several miles. It would be

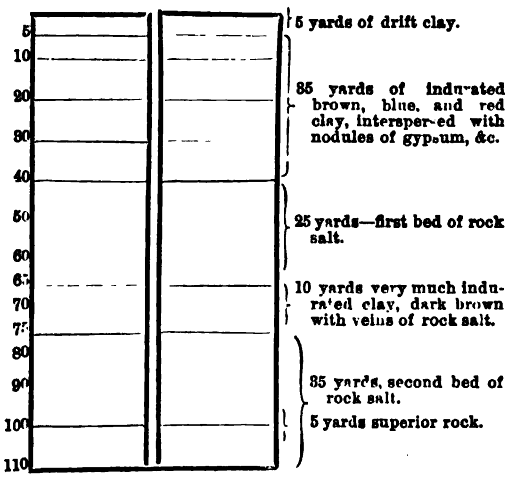
safe to predict the existence of a bed or beds of rock salt, extending three miles in length and two miles in width, though probably varying much in the width. The opinion of competent persons, who have worked in both Winsford and Northwich salt mines, is, that the beds of rock salt underlie the whole district up the Weaver valley, from Northwich to and beyond Winsford. This, though extremely probable, from the similarity of the various strata, and of the layers of salt themselves, is not proved; and no rock salt having been met with, in a sinking or boring sixty yards in depth, about a mile from Northwich, it would seem that the beds can scarcely be continuous. The total thickness of the rock salt in this neighbourhood is about ninety yards; this, allowing 34 cwts. per cubic yard, gives about 150 tons to every square yard of salt surface, or, allowing for the clay in the rock salt, say 120 tons of pure salt for every such square yard. Estimating the district to contain two and a half square miles of salt beds, we have the enormous quantity of 929,280,000 tons of salt. Practically, this enormous quantity is not obtainable. The rock salt is got only in small quantities. The bulk of the salt is pumped up as brine. The fresh water, finding its way to the top rock salt from a higher level, probably where the layers of salt terminate, becomes saturated with salt; and when the indurated clay flag overlying the salt is pierced in sinking, the brine rises many yards up the shaft, and varies in height, according to the quantity pumped up. The top rock salt from whence this brine is derived is thirty yards thick. Supposing all this bed obtainable, we have forty tons per square yard of surface, or 123,904,000 tons of salt for every square mile. This is a fair estimate of the quantity of salt in this district.

Northwich, situated at the junction of the Dane with the Weaver, five miles from Winsford, has more alluvial land in its neighbourhood than Winsford, especially along the Dane

valley. On the left bank, hills of the same clayey nature as those at Winsford approach, and leave very little flat land, till the neighbourhood of Winnington, about a mile or so down the Weaver, is reached. On the right bank there is a fair quantity of flat land, upon which Northwich itself is built. The ground, however, rises everywhere gently at a short distance from the river, except in the valley of the Dane. Northwich, and its immediate river neighbourhood, form a basin, the bottom or lower parts of which are nearly covered with water. This basin is about a mile and a quarter in length, and varies from two hundred yards to more than half a mile in width. A few of the salt works and rock salt mines lie in this basin; but the great majority of them are on the high banks of the river, and on the plateau to the north-east of Northwich, bordering on the famous Bridgewater Canal. Most of the present working mines also lie in this neighbourhood. As far as is known by sinking shafts, the rock salt extends over a district of a mile and three-quarters in length, by about a mile and a half in width, or an area of two and five-eighths square miles. From indications of sinking, observed at Billinge Green, to the south of Northwich, it is very probable that the length of the salt bed may be extended to three and a quarter miles, which would give an area of four and seven-eighths square miles. The quantity of salt contained in the upper bed here would be (if calculated in the same manner as at Winsford) 604,032,000 tons. In the lower bed there would be at least one half more, or say 900,000,000 tons. These figures, which, judging from a good knowledge of the district, are not exaggerated, give some idea of the enormous masses of salt to be met with in Cheshire. If to these are added the Middlewich, Wheelock and neighbourhood, Nantwich, and the various minor districts where salt has been found, the total will be enormous. In referring to these latter places, it is

taken for granted that wherever brine appears there salt rock is not far off; for instance, at Lawton, in the Wheelock district, the most southerly point of the Cheshire salt district, rock salt was discovered in 1779. It was met with first in a layer of four feet, then one of twelve feet, and lower down one of twenty-four yards thick. Doubtless this rock salt extends over the Wheelock district of about four miles in length, as brine occurs at intervals throughout the locality. It is useless speculating further as to the extent of the salt deposits, for facts are not plentiful enough to form any valuable conclusions from, no one having gone to the expense of seeking for salt at any distance from the Weaver or Wheelock, water-carriage for it having been essential till railways came into existence. We know that at Whitley, some four miles north of Northwich, rock salt was discovered, but not worked, owing to its distance from the Weaver.

The, whole or nearly the whole, of Cheshire is covered by the drift. This is the case at Northwich; and in sinking a shaft the first deposit met with is the drift, in which, as usual, are met granite and other boulders, many of them striated; also fragments of coal, and at times fossil shells, teeth of fossil elephants, &c., &c. This drift clay extends four or five yards downwards. The next 30 to 35 yards is



Rock salt for 5 yards lower.

composed of a number of layers of marl and clay, more of less indurated, and interspersed with bands and nodules or gypsum.

This clay is either of a blue, brown, or reddish brown colour, chiefly brown and reddish brown. The miners, in sinking, speak of the various clays as *metals*, and the gypsum as *plaister*. The existence of gypsum in the clays overlying salt has been proved in almost every deposit. Occasionally fresh water is met with, about twenty-five to thirty yards down. At a depth, varying from thirty-five to about sixty yards, according to the locality and the elevation of the ground above the river level, the first bed of rock salt is met with. Immediately over this bed of salt is a stratum of very hard clay, almost like stone. The miners speak of it as *flag*. It is immediately below this flag, and upon the top of the rock salt, called the rock head, that brine is met with. The existence of this first bed of rock salt was made known in the year 1670, when boring for coal at Marbury, about a mile to the north of Northwich. (Brine had been known long before, as in some places it came very near to the surface, through rifts in the flag before mentioned). The surface of the upper bed of rock salt is very uneven, as far as it has been laid bare. It seems as if it had been exposed to strong currents of water, or had been subjected to rain and floods. There are numbers of miniature valleys all over it. The thickness of this deposit is about twenty-five yards. The rock salt is mixed with the same kind of clay that is met with above it, and it takes its prevailing tinge of reddish brown from the greater proport on of clay of that colour dispersed through it. The specimens of rock salt before you will show the nature of it, from the purest white, destitute of clay, through the various shades of yellow, brown, and red brown to dark red brown. The darker the colour, the more the proportion of clay. By looking at those specimens

where the salt has been dissolved and the clay left behind, a general idea of the very irregular, but still, to some extent stratified manner in which the clay occurs, will be obtained. Thin bands of bluish clay will be observed running amongst the red brown. Here and there nodules of gypsum are met with. The distribution of clay amongst the salt is extremely irregular, varying from less than one per cent. of the mass to more than thirty per cent. It was more than one hundred years from the first discovery of this bed of rock salt, before any one thought of searching for more at a greater depth; but at Lawton, the first bed being only a few feet thick, the boring was carried on through the indurated clay below, and another stratum of salt was discovered. This, being but thin, was again passed through, and the still underlying indurated clay penetrated, when a much thicker bed of superior salt was discovered. As soon as this discovery was made known, Mr. Gilbert, the agent of the Duke of Bridgewater, in 1781, bored through the indurated clay (which in the neighbourhood of Northwich is about ten yards thick, and interspersed with thin ramified veins of rock salt, of a pinky colour, and containing much gypsum), and met with the lower bed of rock salt. The quality of the salt for the first twenty yards was very similar to that of the upper layer; but on passing through a thin very hard band of dark clay, about five yards of much superior salt was met with, and it is this salt that has been mined ever since. The thickness of the lower bed at Northwich is about forty yards. Borings have been made lower still, and shafts sunk, but no thick layers of salt discovered. A shaft of sixty feet gave the following layers: *rock salt, indurated clay, mixture of clay and salt, rock salt, indurated clay, rock salt, indurated clay, mixture of salt and clay.*

The upper bed of rock salt, locally termed Top Rock,—for when rock is mentioned, rock salt is always understood,—was

exclusively worked for more than a century. The method of working before the invention of steam engines was, by sinking a shaft down some considerable distance towards the rock salt, but not too deep (for the salt had to be brought to the surface by a windlass and rope), then running a tunnel at right angles for a short distance, and finally sinking another shaft to and into the rock salt. A second windlass was at the end of the tunnel over the second shaft. These shafts were called *sumpf* shafts, and when steam engines came into use, these fell into disuse, and for some time a single shaft was used. The miners did not commence to mine the salt as soon as met with, for the water required keeping out of the mine, and the shaft was timbered and puddled at the back. It was necessary also to have a solid roof over the heads of the miners. The layer of rock salt left behind was not very thick, and frequently the salt was mined through to the metal or clay below. To support the roof, pillars about five yards square were left, having a distance of twenty yards from each other.

After the discovery of the lower bed of salt, the upper mines were gradually abandoned, as many of them were becoming unsafe. The lower mine is worked in a similar way to the upper. Originally it was thought pillars of five yards square would suffice to support the roof of the mine, the more especially as the thickness of salt left unworked was some twenty yards. So strong a faith had the miners of fifty years ago in the supporting powers of this mass of salt, that they expressed the opinion that the mines would be quite safe without any pillars at all. Time has proved this to be fallacious, for all the mines with five-yard pillars have either fallen in or are in too dangerous a state to work, and pillars are now left of from eight to ten yards square and twenty-five yards apart. At Winsford, where the mine is

deeper than at Northwich, it is found necessary to leave pillars of twelve yards square.

The method of working salt mines depends materially upon the thickness of rock salt worked. In Cheshire, as only from fifteen to twenty feet of salt is "got," it is only necessary to leave pillars at certain intervals. For instance, in olden times, it was considered sufficient, in a square of twenty-five yards, to have one corner pillar within the square, while at each of the other corners, but outside the square, were pillars, forming, of course, corner pillars within the contiguous twenty-five yard squares. Sometimes, instead of only leaving pillars, a continuous wall of rock salt was left, thus forming large chambers. An extra number of pillars are left in the neighbourhood of the shafts. In the present mines there are two shafts. The two entrances to the shafts generally fall within a square having four massive pillars at the corners.

In the Carrickfergus salt mines, the arrangements are exactly similar to those of Northwich. In the famous mines of Wieliczka, in Austrian Poland, the salt is worked in several stages, separated from one another. Kohl thus describes them: "These mines each consist of five stories, one above another, and each of these stories is made up of numerous chambers, cells, and caverns, connected by horizontal passages. The different stories are connected by perpendicular shafts, or winding stairs. The descent to the uppermost story is thirty-four fathoms deep. Between each of the different stories an interval is left of fifteen or twenty fathoms."

In Transylvania, where the rock salt is very thick and pure, the most common way of mining is to commence at the bottom of the shaft, and to work round in a circle or ellipse, gradually getting larger in circumference as the descent increases, but still not to bring the slope of the roof

at too great an angle. The appearance of the mine is that of a cone, or sugar loaf. The salt frequently lies only six or seven fathoms from the surface, and the depth of the pit is often eighty or one hundred fathoms, and the diameter of the sole or floor of the mine some thirty to forty fathoms.

The method of working the Cheshire mines is as follows. The miners commence, after having sunk the shaft to the depth of the sole or floor of the mine, by what is called roofing; that is, picking away with sharp iron picks immediately under the roof that is to be of the mine. As soon as they have made an opening wide enough, they blast off more of the rock, and work inwards, forming a chamber about five feet high. This formed, they always keep it in advance, blasting off the rock salt from the edge of the slope reaching from this chamber floor to the sole of the pit. The salt is loaded into waggons, which run along small railways to the mouth of the shaft. The men engaged in blasting the rock and squaring the walls and pillars (for these are left quite square and well hewn), are called *miners;* those who load the trucks and convey them to the shaft are *ferriers.* They are a fine set of men, and their occupation, compared with coal miners, is a very healthy one. The mines are of a very equable temperature, and sufficiently warm for the men to work without their shirts. Being lofty, the air is pure, except occasionally, when much blasting takes place, then the sulphur of the gunpowder remains hanging in the mine, and renders it almost impossible for the men to work.

Many of the mines are of considerable size, and some of them increase at the rate of about an acre annually. The quantity of rock salt mined is small compared with coal. No mine in the district yields above forty thousand tons per annum. The demand for rock salt being small, there is no need for a large production. The price for many years has been very low, so low indeed as almost to surprise any one

unacquainted with the trade. The very finest rock salt, lumps and small together, called Prussian rock salt, has only varied for many years from 2s. 6d. to 3s. 6d. per ton at the pit. The inferior or clayey rock salt has been frequently sold at 1s. to 1s. 6d. per ton. The very finest rock salt, ground fine by powerful machinery, costs only 6s. per ton at the mine, and specially picked fine lumps for cattle only 6s. 6d. per ton.

Rock salt mining is more free from danger than most kinds of mining. Accidents are very rare. No explosions occur, for there are no deleterious gases. There are no falls of earth as in coal mines, for the rock salt is extremely tenacious, and the miners never undermine it, but always blast it, and that quite safely. The two great dangers to which rock salt mining is exposed, though they rarely result in loss to human life, are the falling in of the mine bodily, or of the shafts and neighbouring earths, and the breaking in of brine either at the head of the top rock salt, or from old mines long disused and full of brine. As these phenomena are peculiar to the district, a short description will enable any one to clearly understand the accounts met with from time to time in the papers.

In the immediate neighbourhood of Northwich, more especially in the districts of Dunkirk and Witton Brow, are a large number of very deep holes, most of them now filled with water, though occasionally one may be seen with but little water in. In the latter case, a correct appreciation of the size of these rock pit holes, as they are called, may be formed. They vary from thirty to fifty or more yards in diameter, and present the exact appearance of a funnel, the sides sloping very rapidly for thirty or forty yards down. They are caused in the following manner. When the mines in the top rock were abandoned, the shafts were filled up, and in time their position was scarcely known, or

only marked by a slight hollow, sometimes having a little water in. The old mines become full of water and brine, and as fresh water soon eats away the salt, the fresh water that finds its way down the shaft commences to eat away the shell of rock salt not mined near the shaft. This process continues slowly from year to year, till the salt is eaten entirely away round the shaft, and the neighbouring metals begin to fall into the excavation of the old mine. The whole of the interior of the old shaft keeps crumbling in from the bottom upwards, and the clay spreads itself as mud all over the floor of the old excavation. No sooner is the shell of earth left too thin to support itself any longer, than the whole mass falls in with a thundering noise, forming a narrow but extremely deep hole. After this has occurred, the hole keeps widening at the top every hour, and becoming more funnel-shaped. It is an interesting sight to see one of these holes soon after it has fallen in. In May, 1871, one fell in close to the Platts Hill Rock Salt mine. For some days tons of clay metals, undermined and loosened by the surface water draining into the newly-formed hole, kept falling into the abyss with a tremendous din. Like almost all the other holes, this is now full of water. The clay soons forms a soft mud, and fills up the old excavation, choking the communication, and thus allowing the water after a lapse of time to rise to the surface. At times this water forces another passage, and the whole mass rushes into the old excavations, and drains the Rock pit hole for a time, till it again becomes choked. When the hole near Platts Hill fell in, the miners were at work in the lower mine, and were not aware of it though they were directly below it, and though it was so near the shafts of the mine as for a considerable time to cause great anxiety, lest the whole of the clay earth near the hole should slip into it, and carry away the upper parts of the shafts with it.

A few of the lower mines, having very small pillars, have

fallen in, and are now full of water and brine. In one case, the rock salt forming the roof of the lower mine separated from the indurated clay lying between the upper and lower rock salt. In several mines, the pillars show symptoms of cracking and crumbling to pieces owing to the superincumbent weight.

The sudden falling in of these holes is not so common as the gradual sinking of parts of the district. The most singular hole of the kind we are speaking of is one in the neighbourhood of Marton Hall, about two miles to the west of Winsford. This is the hole that was referred to in *Nature* of January 25, 1871, in a short notice, very full of mistakes. In the number of February 8, 1871, the editor inserted a communication of mine on the subject, explaining the matter. The peculiarity of the Marton sinking is, that no mines have been worked in that neighbourhood. It is probable that the brine pumped up so freely at Winsford must have worn a deep river-like hollow in the upper rock salt, and that the strong "flag" overlying the brine continued to support the superincumbent strata for a long time, but, the cavity becoming too large, the flag cracked and broke, letting all the upper strata into the hole below.

The next great danger is from water, generally in the shape of brine, for nearly all the water met with underground, especially if near the rock salt, is very salty. It has been before pointed out that the brine runs upon the rock head. It is not met with as a deep running stream or river, as is frequently said, but percolating through the neighbouring overlying strata, and running into the bore hole or shaft, at times very rapidly. It is not found everywhere, for frequently, in sinking, a dry rock head is met with in one shaft, whilst in the next, only a few yards distant, the brine runs so fast into the sinking as to flood the sinkers out, and cause the shaft to be given up. The rule is to find brine.

It is absolutely necessary to prevent this brine from running down the shaft into the mine, as also is it to prevent the surface water and the fresh water of the upper clay strata from getting into the shaft. To prevent these accidents, it is usual to cylinder the shaft with iron cylinders. The fresh water is collected in a third shaft, sunk to form a reservoir, and then pumped out. If it reaches the rock salt at the back of the timbering or cylinders, it soon eats it away and destroys the shaft. More than one mine has been lost by the breaking in of the brine. It never comes so rapidly as to cause any fear that the miners will be drowned. One mine was filled partly with brine, but, after the shafts were cylindered, it was pumped dry, and is at present in work.

Much more dangerous, and far more difficult to deal with than the irruption of water or brine down the shaft from the rock head, is the bursting in of brine from neighbouring disused mines that have become filled with it. This rarely occurs, but two instances have happened in the Platts Hill mine. The boundary of the district belonging to the owner of the mine was conterminous, on the north and part of the south sides, with the boundaries of some old abandoned mines. The situation of these was well known, and their distance from the workings of the present mine supposed to be clearly understood. However, in blasting one day, the rock salt did not come away into Platts Hill mine, but seems to have fallen into an old excavation, for immediately after the shot was fired, as the miners say, brine began to run through the chinks and small holes in the rock wall. Fortunately, these holes were but small, and, equally fortunately, they occurred in a corner of the upper chamber of the rock, near to the roof. This enabled the proprietor, by skill and perseverance, to form a barrier of sixteen-inch square balks let into the rock salt of the roof and floor, and banded together and stayed by strong *lean-to's*. The force of the brine was

above one hundred and twenty pounds to the square inch, and on one occasion, forcing its way into a flaw in one of the beams, it split it to pieces. This barrier now stands firmly, and is covered over with a deposit of salt. Brine still oozes from it in small quantities. A short time since another hole was driven in, but still, fortunately, a very small one. It has been nearly stopped. These accidents occurred through the proprietors of the old mine having worked past their proper boundaries. The difficulty in stopping the holes is great, owing to the rock salt being thin and fractured. If the hole was a clean bore, there would be no difficulty in stopping it.

As nearly the whole of the brine at present used in Northwich is obtained from these disused mines, it may be interesting to explain more about them. When the brine running on the rock head began to fail, it struck a few of the mine owners that, if they could only utilise some of the disused and abandoned mines as reservoirs, into which what little brine there was might run, and also the fresh water might flow and become saturated by dissolving the rock salt, they would have an enormous supply of good brine. This brine could not well be obtained up the old shafts, as many of them were in a bad condition and unsafe, especially the long abandoned ones, that were full of water up to within about forty yards of the top, there being some sixty yards of brine in the shaft. The method followed was either to sink a shaft in the solid land and rock salt immediately adjoining the old mine full of brine, and then tunnel till within a short distance, and finally cut, by a sharp tool, a hole of some four or six inches diameter; or else to choose a good mine nearly worked out, and tunnel through the wall of rock lying between it and the old mine, and thus let in the brine. Both methods have been pursued, though the latter is by far the cheaper of the two, when you have a mine nearly worked out. The force of the incoming brine is enormous, and drives

everything before it, the men who have finally pierced through to the brine being whirled about like corks on the top of the brine, and lifted up the shaft for a considerable distance. When it is understood that the level of the brine in the shaft of the old mine is nearly sixty yards above the hole made for it to fill the new shaft, its power can be imagined.

There is one more extremely important feature connected with this brine. It must be evident that it is not possible to pump up brine sufficient to form one and a half millions of tons of salt (say six millions of tons of brine annually), without leaving a cavity of some kind. The whole of this one and a half millions of tons of salt is dissolved out of the upper bed of rock salt, with the exception of such as is pumped from the lower mines in Northwich. If we take Northwich, which shows very clearly the results of this pumping up of brine, we may calculate that in the district around five hundred thousand tons of salt are annually made, and nearly four-fifths of this comes directly or indirectly from the top rock salt. In round numbers this gives two hundred and forty thousand cubic yards of salt pumped up, or say a layer of one inch thick over the two and five-eight square miles that are supposed to have rock salt underneath. Thus we might expect a gradual sinking of the whole neighbourhood of one inch annually, supposing the waste of salt to be distributed equally over the whole district. This is not so, however. We pointed out previously that the upper surface of the top rock salt was furrowed with miniature valleys. In these valleys the brine runs, and when a shaft is sunk into one of them, or near the junction of a number of them, the various brine currents run towards the shaft and eat the salt rock away, till they become fully or nearly saturated. These brine channels grow wider and deeper, and the superincumbent land gradually sinks, following the waste of the rock salt; hence, in the town and neighbourhood of Northwich,

several of these brine-streams can be traced through the sinking of the surface. One part of the town of Northwich has been artificially raised many feet, and it still keeps sinking. In several other parts there are strongly marked sinkings, whilst a few yards away the land stands firm. The most remarkable sinking is the Top of the Brook, locally so-called. Seventy years ago there ran into the river Weaver, between Northwich and Anderton, the Witton or Peover Brook, and into the latter, in the same neighbourhood, two or three smaller brooks. The whole of the meadows through which this brook ran, for the last half mile of its course, have gradually sunk, till they are covered by a large lake of water, at present about one hundred and fifty acres. This is no slight sinking; on sounding it, during the present year, (1872), the depth was found to vary from five and seven yards in most spots, to more than sixteen in the deepest; and for long distances together, the depth kept an average of above twelve yards. This lake is more than half a mile in length, and the same in its greatest breadth. The whole neighbourhood is still sinking, and must continue to do so till the top rock salt is exhausted in the course of the brine streams.

In the course of this paper, it may have struck most that rock salt is found in very thick beds or layers. This is the case almost everywhere. The following will show that the Cheshire rock salt strata are comparatively thin :—

		ft.	ft.
Northwich	...	75	120
Winsford	...	90	180
Carrickfergus	..	160	—
Middlesborough	...	100	but not passed through.
Stassfürt	...	1000	pure and impure.
Ischl	...	1500	as worked.
Sperenberg	...	2810	as found in boring in 1870.

These are but a few of the various rock salt deposits, but suffi-

cient to show their immense thickness. How have they been formed? The answer to this question is difficult, and no geologist feels quite convinced that he can satisfactorily account for them. The best plan to endeavour to understand ancient formations, is to search out for something similar occurring in the present time, and then to argue from the known to the unknown. It would seem that, in nearly all periods of the world's history, salt has been deposited. At the present time we find a large number of salt lakes, in which and on which salt is forming. Perfect crystals of pure salt have been brought up from the deepest parts of the Dead Sea, one of the most salty lakes in the world. In the Steppes of Asiatic Russia, are numerous salt lakes, such as Kosiak, Inder, Elton, &c. The salt forms on the surface of these lakes so thickly as to form crusts strong enough to support horses, camels, and carriages. Where the lake is very shallow, the salt forms at the bottom as well. The Runn of Cutch, in India, is a remarkable district. Lyell speaks of it as follows: "The Runn of Cutch, which is seven thousand square miles in area, is neither land nor sea, but is dry during a part of every year, and again covered by salt water during monsoons. Some parts of it are liable after long intervals to be overflowed by river water. Its surface supports no grass, but is encrusted over here and there by a layer of salt about an inch in depth" (*Manual of Geology*, p. 295). Our English salt deposits are connected with the new red sandstone formation, and are always accompanied by clays and gypsum. Wherever we find salt now being formed, it is always in connection with salt lakes or marshes. That the salt beds of former ages were so connected, I think may be clearly proved.

In endeavouring to account for the rock salt deposits, I shall principally deal with facts that have come under my notice, and draw inferences which seem justifiable from them.

Every bed of rock salt is more or less mixed up in an irregular manner with clay. The specimens before you illustrate this. Generally, the formation rests upon clay, and frequently the different strata are separated by layers more or less thick of clay. Again, when the salt deposits cease, the clay deposits continue, and, as in Cheshire, are not covered by any other formation except the drift. These clays, from the foundation of the series to the very top, are all of the same nature and colour; and as those overlying the salt beds are perfectly free from salt, I should judge them to be of fresh water origin, and deposited by streams or rivers, not in the open sea, but rather in wide shallow lagoons or marshes, at intervals overflowed by the sea, but finally disconnected from it, and forming purely fresh water lagoons, in which the clay brought down by the rivers and streams was deposited. I suppose then a large flat piece of marshy land lying on the banks of a river and overflowed by the tides, probably shut in by hills on each side, and running some distance into the land. I say this, for no rock salt formation is either very long or very broad, but of small area and isolated. This we will suppose to be covered at unusually high tides by the sea, and for a time formed into a shallow lake. High river floods and very high tides continually overflow it, but ordinary tides and small floods do not affect it. The water, as in the Asiatic salt lakes, is slowly evaporated by the sun and wind, and in time becomes saturated brine. As soon as this occurs, salt commences to form at first on the margin of the lagoon. If the evaporation is rapid, as under a tropical or summer sun, the salt will form first on the surface, as we have seen in the Asiatic lakes, and sink to the bottom, or perhaps form a crust. If the evaporation is slow and the water shallow, the salt will form at the bottom, especially if the crystals have any salient points to form from, or if there are any hygroscopic salts contained in the saturated brine;

for instance, magnesium chloride, which is so common in rock salt deposits, will actively assist the deposition of salt crystals at the bottom of the fluid. My opinion is that the rock salt was deposited by slow evaporation at the bottom, and not formed as a crust on the top, and then sunk to the bottom ; though it is possible some portion may have been so formed. The reasons for forming this opinion are the following. If you take a drop of supersaturated brine and place it upon a glass slide, and view it under a microscope, say with one inch objective, as the water evaporates, small squares and parallelograms of *transparent* salt crystal keep almost imperceptibly stealing into view. These increase in size in all dimensions, forming cubes and parallelopipedons, but chiefly cubes; and it is interesting, if the slide is sloping, to view these as they increase in bulk, rolling over to the bottom of the slide, often carrying with them other crystals. All these crystals are perfectly transparent and regular, though they grow into one another and upon one another in all directions.

I now wish to call your attention to the piece of rock salt before you, overgrown with cubes of transparent salt. These are of the nature of those seen on the slide. Those cubes,—which are formed upon a piece of ordinary rock salt,—have been the growth of about ten years. The piece of rock salt was lying in supersaturated brine in a depression of one of the rock salt mines into which brine from the rock-head forced its way. The evaporation in this mine has been very slow, and the result is numerous crystals of rock salt, in every way similar to the usual rock salt. These crystals are free from clay, owing to there being no irruption of water during their formation. Supposing, at this stage of their growth, a flood of muddy water had inundated the district and covered them some inches deep, the mud would have quietly settled itself in every cavity, and amongst the crystals,

which would lose their sharp edges to some extent, and become irregular in shape. The mud would show signs of stratification, but, owing to the irregularity of the crystallisation, would not form a clear band, except the flood brought an unusual quantity down, and more than covered the crystals. We have only to imagine the same process of slow evaporation to go on once more, and the crystallisation commences and continues, the crystals forming in all directions, and growing into one another, so as to destrôy all regularity of crystallisation, and make the salt appear a very irregular mass. During all this time, we are bound to suppose that a gradual sinking is taking place, or else a contraction of the crust of the earth through cooling, which is tantamount to a sinking. As in all geological questions time is largely drawn on, I can see no reason why, if sufficient time is granted, the thickest deposit of salt might not be formed in the way indicated. The reason why I prefer slow evaporation to rapid is, that when salt crystallises by heat, say 100° and upwards of Fahrenheit (I cannot be certain of the point), the crystal is entirely different to that formed by evaporation, say at from 60° to 70° Fahrenheit. The latter crystals I have described, the former I exhibit specimens of. You will see that they resemble hoppers, or hollow pyramids. It is very interesting to put a drop of supersaturated brine on a glass slide, either previously heated, or to be heated after the brine is placed on. The crystals formed in this case will start as small cubes, which seem to add strips on each side simultaneously, and keep increasing, whilst the angles seem to be thickened.

If these hoppers remain long enough in the solution, and the heat is continued, they join, and six of them form a cube, as you will see in the other specimens before you. It is only in the evaporation by a low heat, of say 110°, that these crystals form, any degree of motion tending to break

them. All the fine kinds of salt made by great heat produce broken crystals. Perfect crystals are formed at the sides and bottom of the pan. As I have never yet discovered any of the crystals produced by heat in rock salt, I come to the conclusion that the rock salt must have been produced by a very slow evaporation, and as I also think in shallow water; for it is almost impossible for very deep bodies of water to become supersaturated, and the evaporation to produce crystallisation at great depths. The Germans have written much more largely on rock salt than any other people, and have discussed the question of its origin very lengthily, though not always satisfactorily. It would have occupied me far too long to have entered into the question further, or to have treated of the manufacture of white salt, and its distribution over the whole world from Liverpool.

PHILOSOPHY WITHOUT ASSUMPTIONS.

BY THOMAS P. KIRKMAN, M.A., F.R.S.

PART I.

THE problem of metaphysics has been propounded thus: What is? and often with the addition, What must be? For the former question I have a profound reverence; but I do not believe that its scientific discussion, as a direct and first question, is within reach of my human powers. For the latter question, as a problem of the science either of men or angels, I have a profound contempt. In my judgment, the terms *necessary* and *necessity*, which accompany the 'must be's' of philosophers, are the meanest and mouldiest of the rags with which Ignorance tries to hide her nakedness. In mathematics we have *must follow* in plenty, but no *must be*. The question which I propose to myself in philosophy is this: What do I find for myself without making unproved assumptions, and with demonstration that I can write down, so that you may understand me, and find it and demonstrate it for yourself, without any assumptions? When I say, I know a thing to be, I mean I find it, and can show you how to find it. I ought to state exactly what I mean by the words 'assumption' and 'demonstration.' An assumption is the acceptance without proof of the truth of a proposition, of which truth proof may, without a flat contradiction, be demanded. The determination to make and to grant no assumptions, comes to the same thing as the Cartesian process of doubting of everything of which doubt in any way is possible. I think it a better way to the same thing,

because it avoids the objection—You are affecting to perform the impossible. This rule of demanding proof, when proof may without evident absurdity be required, reduces my stock of scientific propositions at the start of my philosophy to the fundamental one of Descartes, which I write thus: I am, and I know that I am, a conscious thinker. About the cosmos, about my body, or other bodies, or other thinkers, I at first know nothing, that is I will allow nothing, till I know how to find and to demonstrate it. If you have a taste for hair-splitting between I am, and I know that I am, and for distinctions on paper of your own making in figurative Latin derivatives between direct consciousness and reflex consciousness, I shake my head, and cannot go with you; because I should have to make this unproved assumption, that you do, although I do not, see a difference of meaning under that famous distinction in manufactured words. I would demand proof of my first proposition, I am and I know that I am a conscious thinker, if I could do it without a contradiction. But how can I say, I am, and I know that I am, doubting and demanding proof that I am? It is pure *bosh;* a silly pretence to caper about myself in a circle without a radius. Before I speak of demonstrations, I must beg you to understand exactly what I include under the word thinker, or thinking, when I say I am consciously thinking, or I am a conscious thinker. I include all that Descartes carefully included under his cogitatio, when he wrote, "Cogitationis nomine intelligo illa omnia, quæ nobis consciis in nobis fiunt quatenus eorum in nobis conscientia est." That is, I include every state or change of consciousness of which at the moment I may be aware, every sensation, every volition, every will-effort, of which I may be conscious: so that 'I am' includes 'I will,' when will is in conscious effort. I may be thinking that I see, that I hear, thinking that I affirm or deny; thinking that I am endeavouring, that I have ceased to endeavour;

but in all this affirmation of my conscious thinking, I make no assumption that there is in the cosmos any other thinker or being whatever, out of my conscious self. The 'cogito, ergo sum' of Descartes has been misunderstood. He tells us that while it is wrong to say, I see, or I walk, therefore I am; it is right to say, I think I see, I think I walk, therefore I am. He means that I am can be deduced only from mental acts, as distinct from bodily. It is generally agreed that it was an error on his part to attempt to deduce it at all. I am now thinking that I am holding up my arm, and that I see it raised. I am quite certain about the mental will-effort I am making, which, as I am led to believe, initiates and keeps up a certain charge of energy, through a machinery whose details are to me a mystery, from my conscious will. I am also certain, from habitual experience and sure appeal to proof next moment, that I can continue or suspend that will-effort at pleasure. I am thinking not only that I see, but that I feel what I call my arm raised; that is, I certainly have in consciousness, the familiar visual and muscular sensations which accompany that will-effort, and I have no doubt that those sensations will vanish from my consciousness when I (the thinker) choose to suspend the effort. But in all this I make no assumption that what I call my arm has any existence out of my consciousness, that it is more than my perception or idea of it, or anything with which my will can come into conflict as a real external resistance. That it can so come is a proposition of which proof may be demanded without contradiction; and I demand it. I have not assumed nor asserted that it can, in affirming all my thinking about it; all these being affirmations of mere facts of consciousness. I can find a proof that it is more than my perception of it, such as it is, and I can show you how to find it,—but thus only—by finding my thinking self in a relation of conflicting will-effort with something that is not my own will-effort, in

this arm that I grasp as well as see. The proof is an appeal to two simultaneous facts of consciousness; one, that I am putting forth a will-effort with what I call my hand; the other, that my effort is baffled, so that I am prevented from a familiar satisfaction in consciousness, which accompanies my thinking of the free movement of my hand. I infer that there is a force not my own which baffles me in the portion or locus of the cosmos which I call arm; and I have no way of getting at my notion of such a force out of my consciousness, and independent of me, but by such inference. We shall consider this inference more closely in what follows.

I must tell you what I mean by a demonstration. A demonstration is either a deduction of logic from proved premises, or it is the testimony of my present consciousness clear of all assumptions; or it is truth constantly verifiable to me the thinker, by facts, or by inference from facts in my consciousness which I can repeat again and again without making any assumptions. It is impossible for me to divest myself of my conviction that I am is a cosmos of real force and of other thinkers; but I can see to it that no assumption of the existence of persons or bodies, not even of my own body, shall lurk in my propositions, till I have found out how to demonstrate such existence.

There was a time when I had the advantage of studying and working out first the steps of my certain knowledge without being encumbered with imaginations and prepossessions, and when, with mental power inferior to my present, but sufficient for my young task of perception, comparison and memory, I arrived by logical though unformulated steps at sure convictions, without any risk of making unproved assumptions. I began that course of study with this 'I am' and 'I will,' when I first exerted my — well, let me for once have a soul above monosyllables, and use the grand word of which our philosophers have made the immortal

discovery—my *spontaneity* in the womb, and when after birth I persevered under the tuition of the forces around me in the same experiments. I had then no theory or assumption in the world about my body or other bodies. If you had seen me kicking in my cradle, without an idea in my consciousness about the number or shape of my limbs; nay, without any definite notion of my having a body at all; if you had seen me make the first discovery of what I call my foot, and haul it to my mouth, and make those bold efforts to swallow myself; you would have seen a learner who, from this very starting point 'I am,' which includes 'I will,' when will is in conscious effort, made his way without any assumptions to the best part of the trigonometry, geometry, and mechanical philosophy, which is now in my brains; and this by purely mental operations and comparisons of states of consciousness and will. The reference to my infancy forms, however, no part of my argument to-day. Science, in its beginnings, was easily mastered then, in its due order: it is not easy for me to state it here, amid all the abuses of language, and the assumptions and false simplifications of what goes for philosophy.

Having explained my terms 'assumption,' 'demonstration,' and 'thinker,' I remark that I am making no assumption, nor taking anything for granted, when I say I am, and I know that I am, a conscious thinker. For how can I be scientifically affirming that I am assuming my existence, without affirming that I am? And if I am affirming scientifically that I am, how can I be assuming it? Or how can you inform me that I am assuming that I am, before you have conceded and affirmed my being? Some small assaults on this 'I am' should be noticed. Great metaphysicians have tried to frighten me at this point, by asking, How do you know that you are not at this moment dreaming, and how can you prove that you are not dreaming? I do not want

either to know or to prove it. I know that I am thinking, and I affirm no more. Time enough for me to talk about dreaming when I have demonstration of dreaming. Others have attacked me thus: All things are in a constant flux; therefore your 'I am' is not the same truth two seconds together; it becomes 'I was;' and the ego is always changing. I answer, that all things are in a constant flux is a proposition of which I demand proof, for I can demand it without absurdity; and proof will not be easy. The simplest case of the constant flux is continuous linear motion, which in theory is possible at all finite velocities. Suppose now a bullet rolling continuously across this table at the finite velocity of one inch in ten thousand years, how would that example of the flux help your assaults on my 'I am'? Are you quite sure that you can prove to me that all things in the cosmos are not, instead of being in constant flux, in constant alternation of flux and pause? Another remark often made is, that 'I am' contains an assumption, because self cannot be posited without a contrasted not-self. Of this negative proposition I demand demonstration, a demand which is not absurd, because the self of the preceding moment appears to be contrast enough for the self of this moment. To a listener 'I am' seems vague: he may fairly demand, What are you? To this, without going out of my depth into the question, What is? I answer, I am and I know that I am the conscious thinker that I was a moment ago. That is sufficient for me, and it amounts to this, I am in time.

All this is a long story about I am, but it will be pardoned by those who know what metaphysical quibbling is. Professor Huxley has somewhere propounded in one of his sermons, that instead of 'I am,' 'Thought is' should be the starting point. It seems queer that thought should be posited before a thinker, and apparently without one. How am I to find this beginning? How am I to discover that thought is even

in my own pate, till it has dawned upon me that I am a thinker? I have to find this beginning, by beginning before the beginning, As to thought being in other minds, or in no mind at all, these are matters that, to a sceptic like me, demand a little proof before I can allow them. Here is a muddle, or, to speak more reverently of a sermon, a mystery at the outset. I do not say it is not a proper thing to find in a sermon, nor that Professor Huxley is a bit less a fine preacher, because I do not understand his Reverence. We have here an example of philosophic simplicity and frugality, in making one word *thought* do duty for two conceptions, wide as the poles asunder; one the *cogitation* of Descartes, the act of a conscious mind; the other *cerebration*, a movement or vibration of brain of which the owner is not conscious, and which Physiology can imagine, but not verify. That virtuous economy which contents itself with one term for two incongruous and irreconcilable meanings, is not without its use and praise in theology: it is good in sermons; but it will hardly become the rage in science even though a Huxley should set the fashion. It is very wonderful to behold what perilous feats some of our philosophers, — for example, Messrs. Taine and Spencer — will attempt, in order to jump clean out of themselves, and to explode the vulgar notions of subsisting self-consciousness and will. I grant you, their object is exceedingly scientifical; forsooth, to simplify the cosmos! to get it all down upon paper, all labelled in the bottles, and working in the toy-machines of the laboratories, until finally we have found that one beautifully simple formula of Evolution, all-resolving, all-constructing, far simpler than gravitation — the very formula you know which somehow the sharp fingers of M. Comte, who saw the whisk of its tail, just missed pouncing upon — the formula in which we shall presently be able to roll up your cosmos into a neat cigarette and smoke it all!

Yes, 'tis a noble ambition, to simplify the cosmos. What a pity that Brummagem does not turn them out a span new cosmos, simple enough for their heads to master!

You will understand that 'I am' does not affirm or include 'thou art,' or 'he, she, or it is,' though 'it' should mean my body; much less does it include what nearly all our philosophers at first assume, as a matter of course, 'we are.' Wherefore, my philosophical reasoning must at first needs be a monologue. I am in search of demonstration without assumptions, that there is any other finite being, conscious or not, than my own conscious self. And I am contradicting and endeavouring to confute those who maintain, that it is impossible to construct a philosophy, unless we at first assume ourselves, mental and bodily, and our correlatives, or as it sometimes stated, ourselves and our events, the correlatives and the events being what these gentlemen choose to invent or to assume. Their first cry at setting out is, Here we are, jolly fellows all, and this is our boat; come along with us, and we will teach you Philosophy; we will teach you Evolution, and our much admired joke about evolving it all out of your consciousness. If I take their advice, I know well what will happen when they get out to sea. If I contradict them, woe unto me! They will turn their unproved assumptions into the direst weapons of intolerance and dogmatism, and I may soon be food for fishes. I say to them, Gentlemen, I admire what little scepticism you have among you; my only fear is that you will not carry it to the extent of mine. I am a reckless and incorrigible sceptic, but I would rather not begin to play at that on board your boat. We will have a little, nay we will have a good deal, if you please, of hardened scepticism here just now, on terra firma at the beginning, and especially about your—'Here we are, and this is our boat.'

I shall have to begin my monologue with considering the facts of consciousness, of which memory is a part. Memory, unless under cross-examination by present tests in my power, is not sufficient for the foundation of a scientific proposition. Her clear records go for something; her blanks go for nothing. We have philosophers of fame, — Miss Cobbe and Dr. Carpenter for instance, — who can make use of the blanks of memory. I may misunderstand them; but they appear to be sure that this did and that the other did not happen, because they have forgotten all about it. I shall not debate about the cause of my being. I want a definite finite verity that I can affirm, besides this 'I am.' I must classify as well as I can the facts of my consciousness. They fall into three well defined compartments. I remember, and I can verify it in a moment, that I have been sometimes in a state of repose, without making the slightest effort of will either to influence or disturb the trains of reverie and sensation, not stirring any of what I call my limbs or muscles, not a finger, not the axis of an eye. That mental state which I call the first compartment of remembered consciousness is a reality, quite certain to me without any assumptions of either body or space; its marked feature is the inaction of my will. There is consent, but not intent or effort. In that state I am the subject of fleeting fancies and sensations, over which I have not the slightest control while the will is not consciously active. Nothing can be detained; the present instantly becomes the past, and accurate comparison of my states of consciousness is impossible. It is all passing sequences, and there is no middle term by the aid of which a logical conclusion can be drawn. I shall not lose time by trying to show, what very likely you all believe, and what most philosophers affirm, that from this purely passive state of changing consciousness considered alone, nothing can be scientifically proved by me about being distinct from my

own; and that it is only when the varying sequences are translated by association into what we learn in conflict of will with the forces around us, that they come to have a real meaning. I need not point to the familiar illusions of the mirror, nor remind you of what you know about the result of observation of the born blind who have received their eyesight by an operation. The new sensations of vision teach them nothing about distance, form, or solidity. From this first compartment of my conscious experience, I cannot pretend to gain any demonstration of being which is not myself.

The second compartment of my mental experience I call that of my ill-recorded will-effort. In this the will is consciously active, but only in the endeavour to solve some purely mental problem, to recall some lost train of thought, some forgotten word or vanished record of memory. In this compartment there is no conscious relation to active resistance, no conflict but with pure difficulties of thought. Because those difficulties occur and are overcome at some mental cost,— I have sometimes known at how heavy cost,— I call the found and remembered state, effort. If I choose I can call it force; or if I choose to reverse the letters force, and call it ecrof, I have a right to do so; for I can give what name I please to definite fact and act of consciousness. I call it *will*-effort, or *will*-force, because I know by ten thousand experiences, which I can repeat and verify at pleasure, that it depends on my will. The sole condition, necessary and sufficient, that such effort shall begin, continue or terminate, is my conscious choice and will. I call it my ill-recorded will-effort, because I find in memory no exact measures or comparisons of it. I remember greater or less effort, but there is no standard, nothing like graduation. I cannot say, after the effort of recalling a forgotten Greek word or a mathematical formula, I will forget all that again and again, and make

repeated comparisons of the efforts expended. I will not undertake to find in this second compartment any more than in the first, the demonstration sought, of finite being not my own.

The third compartment of my experience in consciousness I call that of my related and well-recorded will-effort, or will-force. If in this I cannot find a demonstration of being not my own, I must be content, like other people, to begin my philosophy with assumptions. But I think it is easy for me to convince you, if you are really there with minds like my own, by careful inspection of the facts of consciousness, that there is in those facts a real intelligible and abiding relation, that can be considered steadily as long and as often as I choose, from which relation the sought inference can be demonstrated without assumptions. This will be a confutation of a crowd of philosophers, who will have it that we cannot make a single step without a heap of unproved assumptions. I think also that I can prove the falsity of a leading, favourite, and quite unproved theorem of a fashionable philosophy, that in the facts of nature no closer connection can be observed by science, than that of mere antecedence and sequence; that sequences are all that science can observe and register in the facts of the cosmos. They allow, of course, that facts do happen at one and the same time; but that coincidence is not the closest connection of which science is in search.

There is a second theorem which cuts a mighty figure in fashionable philosophy, of which I at first intended to say something by way of refutation; but the theorem is so utterly futile from the absence of definite terms and definite applications, that I have erased all that I had written. It is hard to confute utter nonsense without catching a flavour of the nonsense. I mean this theorem: That the same antecedents are invariably, and will be invariably, followed by the same

consequents. The futility of it is twofold; first, it is stated that the interval between the nearest antecedent and consequent may be either something or nothing; and, secondly, not a single definite consequent B is either produced or producible in the cosmos, along with its definite immediate antecedent A, in time or in space. And the theorem is propounded without the faintest pretence to demonstration. "We think so and we will have it so." That is all. It is a piece of pure dogmatism. It may have some value as a record of limited and rough observation. As a scientific theorem it is worthless; and ticketed as a theorem, it is just one of the rags with which Ignorance tries to cover her nakedness. It could be easily made infallibly true thus: The same antecedents are invariably followed by the same consequents, excepting only those cases in which they are followed by other consequents.

How am I to set about stating the truth about my active consciousness in related will-effort, where no assumption is permitted? I say that along with 'I am' my will-effort is given, when will is making effort. This affirmation rests on the appeal to consciousness, and it affirms nothing of an external cosmos of resisting forces. I shewed, in speaking of the second compartment, that will-effort or will-force is a fact given in consciousness, a fact known as the condition of satisfaction contrasted with disappointment, as the condition of difficulty found and conquered, facts of consciousness as much as are pleasure and pain. In naming this fact will-force, I made no assumption of resisting force external to myself; for the effort in that second compartment was not made, nor is it remembered, in any relation to resistance acting in the not-self; no not-self being posited or conceived in such will-effort. I say this in order to prevent the cavil which opponents will be forward to make against the argument which follows, that in affirming myself in effort

I am assuming, and not demonstrating, a resisting force in the not-self.

That I am sometimes in repose, without will-effort of any kind, and sometimes in vigorous exercise of that will-effort, is a statement which consciousness verifies, without any assumption concerning the cosmos and its forces outside of consciousness. The most important point for me to study is the exact point of transition out of one mental condition into the other. I have fancied myself to be in my soft bed, so perfectly at rest that I could not, without a certain effort, give a clear account of the posture of what I call my limbs. I have said to myself, It is quite certain that I can pass from this state into the consciousness of exerted will-force against resisting force; and I have asked this question, What is the condition necessary and sufficient in consciousness for this transition? I have deliberately considered this again and again; for it is in moments of calm deliberation, not of sudden excitement, that Science finds her truth. The only answer which I can find, that fits the facts of consciousness (and consciousness, as David Hume remarks, when it suits his purpose, never deceives), is this: I must first, in the freedom of my will, choose what fancied muscles of what I fancy to be my body I will move, and when, and how, and whither I will move them, and then by the energy of my will, I must issue the flash of volition which alone can effect the movement. That is the lesson of consciousness to me, repeated times without number, without hesitation, without variation, without ambiguity, at this crucial point of transition from passive to active experience. And that lesson is worth a shipload of your metaphysical and physiological *must be's*. I am not about to enter on the old debate about free-will. My own subject leads me thus far. At this point of transition I have to choose what to do, and then I have to do it. Pardon one remark touching the free-will question, which I

make without any attempt to shew its value; I grant all that can be said about the antecedents and motives that influence will; but I say, that no motives, no desires, no arguments or antecedents whatever, can issue in the exerted effort of my will, until I choose to put forth the effort. But I have not yet found the demonstration which I seek about being not myself.

I examine the record of memory. I remember once thinking that I moved my finger. Was that an illusion? I think I will try it again. I am sure I made the effort. I think I did move what I think to be my finger, and that I have the power to move it again. Is all that a sequence of mere ideas, or is it more? I assume nothing. I affirm only facts of consciousness. What can I infer from them? Nothing at all about finite being out of your own mind, say the Idealists. Nothing, above all, says David Hume, about what you call your power, or what is in your power. That word *power* and that *I can* of yours is a wonderful delusion. You have merely observed a sequence; you desired your finger to move, and it moved. That is all, a sequence of movement on desire. Power has no meaning. You are deceived by the frequent recurrence of the sequence, and you fancy that your own power brings it about. If you really had the power to move your finger, and were conscious of having such a power, you would be conscious of how you do it, and would be able to tell me how you do it. Can you tell me? asks David. I am obliged to answer in the negative. This sends me into the chamber of consciousness. So, *I can*, I have the *power* to do it, is all an illusion that has arisen from the iteration of a sequence. It is humbling, but it is beautifully simple. O sweet and simple Philosophy, *simplex munditiis!* Observe, sir, I did not say, *simplex mendaciis*. But I think I remember often, too often, just cutting through my cuticle in shaving. I always desired it to heal, and the

healing invariably followed: the bleeding at once abated, and all was right in a minute or two. How is it that it never came into my mind to fancy that I had the power to heal my wounded cuticle? There is reiterated sequence; why is there no inference of power? Perhaps David is mistaken, or, far more likely, he has his tongue in his cheek at this moment. Let us look at his demonstration. If I knew that I had the power, quoth he, I could tell him *how* I do it. What do we mean by telling how? Shall I say, I move my finger just as he moves his? Is that *how* enough? He shakes his head. Then *how* must either mean by which method out of a choice of methods, or else by what exact steps in time and place, when there is but one method. There is but one method; so that he demands by what steps in time and place. But can he prove that there are successive steps in time and place in any act of consciousness, whether in passive sensation or in active volition? Physiologists have made valuable discoveries about the steps of muscular and nervous action, which are the antecedents of sensation, and the consequents of volition; here they can say something about the *how*. As to the *how* of consciousness and will, the truth probably is that it is a flagrant absurdity to put the question, as one capable of being answered by even an archangel in the only terms intelligible to man, distinct from the witness of consciousness, *i. e.*, in terms of time and space. About the fact itself of consciousness, and the act of will, your philosopher has just as wise a tale to tell as he had when he made his first hole in the atmosphere.

Is it not possible, I pray you, for honest men to agree about what is proof that *I can?* If it be what none else can do; if I engage to do it so many times a minute at intervals that I fix, and which neither you nor your guardian angel can predict, and then again at intervals that you may prescribe, if I engage this and do this, should not that be evidence that

I can? O yes, but when we are talking philosophy to simplify the cosmos, *I can* and *I will* must mean just what we please! Let me have your pardon for this digression about worthy David Hume. After all, this mere moving of my finger does look very like a sequence. I will not dispute that point with the mocking or mock philosophers who tell us that POWER and I CAN have no meaning, and who say I CAN and believe it, just as I do, all day long. I am still in quest of my demonstration of being not myself. I think I remember once moving all my fingers at once, or thinking that I did it. I think I am doing it now. It seems real, as well as quite in my power. But it is certain that the desire to do it, and the idea of the apparent movement, do form one of the sequences of nature. But stop, how is this? I cannot do it now. The will-effort is clear enough, but there is bafflement. The sensation of the freely moved fingers, and the closed hand, will not appear in consciousness. I must dwell on this new combination. I cease my effort; the combination disappears from consciousness. I renew it, and I pause upon it, with the sustained effort of my will. Do they call this a sequence? I call it a steady permanence in consciousness. My state is at one moment both active and passive. The name sequence will not describe this fact in consciousness. I affirm that it is a relation, evident and abiding, of my conscious will-effort to a contemporaneous correlative. Neither of these is before or after the other. Together they begin; together they end. I find more than one such permanent relation as I am thinking I press this arm, this hand, these fingers. Where is David? David is dissipated! He knows as well as I that the demonstration from consciousness is all here. From this found relation into which my will-force is brought in consciousness, contrasted with its free action, from all these evident and sustained relations in which I find gradations of more and less, and from the logic and nature of a relation,

which must have two congruous terms, I infer that the contemporaneous correlative to my acting will-force is another force not my own. For force can have true and measurable relation only with force. The relation, I say, I (the thinker) find in consciousness, and from that I infer another acting force; and what is more, from the law of a relation, I demonstrate it without any assumption. Thus I have proof that I am in the presence of being and action not my own.

It is one of the very few good jokes, sir, that we have in metaphysics, to read what David Hume has written on this question in his "Essay on the idea of necessary connexion." What a pity he did not follow Professor Huxley, and call it a sermon. After palavering in the text about the sequences of nature, to shew that the word power has no meaning, without one syllable of allusion to a found resistance, much less to a resistance sustained, he sticks into a short note, in small type, something about the *nisus*, or strong endeavour, which doubtless gives occasion to the vulgar idea of power. Then he hums and he haws a little, and puts together a bit of stuff, firstly, secondly, and thirdly, that would disgrace a pulpit. Well may a writer, I think in the *Fortnightly Review* of last month, admire the stolidity of the reader who does not see the twinkle in David's eye. He delighted to mystify the philosophers and to enrage the clergy of his day. David would have made a famous Doctor of Divinity on a committee of translation or revision. He would have enjoyed the fun of sticking the right translation in small italics into the margin, and a more useful and fashionable one, in bold type, into the text.

This argument is the same, whether the resistance encountered by our will-force arises from our own bodies, or any other bodies, as we call them in the cosmos. Pain taught us very early to distinguish our own bodies from all other loci of force. I believe that all my conceptions of an external

world are derived from contact and conflict with it, exactly like the conceptions of a man born blind, and that the telegrams of light are intelligible only because we have learned from our infancy to translate them into the ideas and practical memories of the blind. The great Berkeley, in his Theory of Vision, made a splendid step in science.

I call my related will-force well-recorded, because it is well-measured, well-graduated, both in memory of experiments repeated again and again at pleasure, and in trained consciousness of present power. At first my will-force is a measurer, my only measurer of force around me. I soon learned in infancy, from *I am* and *I will*, what was easy, and what was beyond my utmost effort. In time a unit of force was fixed; gravitation supplied the most convenient, some obstacle such as I chose to call a pound weight,-by which other obstacles were compared. In time I learned the use of the balance, and had thus a way of measuring my own utmost effort; and my will-force became both measurer and measured. Friction or elasticity might have supplied the unit, but less conveniently. The important thing to observe is, that all my notions of force, including my notions of distance, are only memories or multiples of expended will-effort. I learned distances when I crawled in the nursery, not by seeing them, but by working them through, sometimes in easy effort and more time, sometimes in full strain and shorter time; and I thus by my own movements became master of the conception of space, which I now write down in symbols $s = f\,T$, or space is the product of acting force and of a function of the time during which it acts. And now, when I talk of the distance from me to Sirius, or of the force which is hurling me through space thousands of miles in an hour, I am merely conceiving a vast multiple of my own expended will-effort. I lay no great emphasis on my descriptions of my related will-force as well-recorded and

well-measured; but I beg to remind any opponent, that in criticising my notions he should beware of assuming that the forces of nature with their laws, and the machinery of balances, etc., are all given to him at the outset of thought, before he has learned their value by the conscious efforts of his own will-force. I have seen wonderful arguments constructed by opponents who make such assumptions against what I am here saying, and what I have said in my tract on "Matter, Force, and Atheism."

When I tell you that I find in the cosmos a variety of forces acting in more or less definite loci, the forces and the loci being found and measured by nothing but my will-force, I tell you honestly all that I find. As to that renowned matter, inert unconscious matter, which is neither found force nor found locus of force, I cannot find it. It appears to be a marvellous Jin or Gnome of philosophical superstition; but although I seem to have the same senses and faculties with other men, I cannot find this matter, distinct from force acting in loco. I do not say there is no matter, any more than I say there is no catter. It would be wrong in me to deny the existence of either matter or catter, so long as I am unable to form the faintest conception of either. I grant that the common arguments, We cannot conceive, It is impossible to conceive, are worthless. If any charitable soul will help me by some experiment, either simple or complex, to find this inert space-filling matter distinct from acting and encountered force for myself, I shall be most grateful to him; and I solemnly declare to you that I will willingly believe and confess the existence of either matter or catter, if you will only teach me how to find it at pleasure, whether I can conceive it or no. But so far as I have yet investigated the facts of consciousness and the cosmos, substance, substratum, matter or catter, supposed realities distinct from found force acting in found locus, appear to be fictions of Ignorance, all

empty words without a glimmer of meaning, which to a man of my sceptical turn of mind are fit only for ridicule where they claim to be science, as much as the metaphysical MUST BE's which make up all the evidence produced for their existence. To the idealist I say, I can demonstrate that I am in a real cosmos of real measurable forces acting in measurable loci, all as real as my own conscious being. To the materialist I say, I am quite willing to believe what you tell me about your matter as distinct from acting force, and about its marvellous mathematical attainments and dynamical achievements, on one condition, which you cannot say is unreasonable in an utter sceptic, that you show me how to find it for myself. I hope I shall always have a proper respect for your faith in your fetish; but I must know exactly how to find it distinct from force acting in loco, without the help of a MUST BE, before I am a believer in it.

There is, perhaps, yet room for scepticism to ask this question, How do you know and prove that the acting forces of resistance which you infer from the relation found in consciousness, are not purely ideal and imaginary? I will not repeat here the answer to that query which I have given in my tract on "Matter, Force, and Atheism;" for what I have said to-night is intended as a complement to that essay, not a repetition of it. I will merely say that in a real relation both terms must be real, or both unreal. When I am consciously exerting will-effort, the question, How do you know that you are not dreaming, is, from my experience of dreams, utterly unfair. I reject all appeals to morbid conditions. I have taken pains to examine, on awaking in health, the fleeting memory of my dreams. I have never remembered an effort of conscious will-force. I have been in motion, but only gliding and carried along, never stepping out with a will. I have been struggling or fighting, but besides distress, I have remembered nothing but tossing arms or flashing

weapons; no striking out with a will. There appears to be in dreams no working with a will, and certainly no thinking, comparing, or judging with a will, or dreams would not be what they are. They seem to be a chaos made up of images of our merely passive impressions.

To me it appears that the distinct study of an active and purely passive state of consciousness, is of the first importance, and that our real knowledge is not so much that of mere sequences, as that of relations and ratios of force to will. This, I think, makes up most of our useful certainties about the cosmos. As to your matter, with its necessary and eternal laws, your invariable antecedents and consequents, your developments and evolutions of the unconscious into the conscious, and your grand theorems of conservation of force, and the like, these all sound mighty philosophical; but they are as purely unsupported assertions as the last dogma of the last Council. To sceptics like me, they are utterly unworthy of the name of philosophy; they are dogmas propounded to blind faith, not demonstrations offered to science. I do not wish to offend any one, but I call them rags, the rags of Ignorance. You need not ply a sceptic like me with your *argumentum ad verecundiam.*

Did you ever hear my anecdote, sir, about the debate of my friends John and James? John is a clever man who has made his fortune, and he is great in arithmetic. He can add up long columns with wonderful speed and certainty, he is unerring in multiplication, and pretty good at long division. He is rather philosophical too, and has the power to generalise and simplify. He is proud of a discovery that he has made that all the properties of what he calls the Theory of Numbers, can be reduced to counting and adding. 'However difficult it may appear to you,' he says, 'I can shew you that, at the bottom, it is all counting and adding!' One day after dinner, as he was thus philosophizing, James ventured

to say to his host, 'Are you quite sure, John, of that? Did you ever consider the relation between two numbers, what we call a ratio?' John looked at the man who questioned him on the theory of numbers, and said, 'Hm, bring it to me, I can shew you it is all counting and adding.' 'Nay,' said James, 'you can never express the ratio of one to three by either counting or adding the two numbers, or any set of other numbers; its value has nothing to do with that of either number.' 'Ah,' said John, 'that 's all moonshine and metaphysics. I hate metaphysics.' 'But, John, did you ever hear of the evolution of roots? Is that all counting and adding?' 'All words, mere words without meaning in the true philosophy of numbers; I hate words without meaning,' replied John. Once more, James enquired, 'John, did you ever hear of incommensurables?' 'Now, that does show your ignorance,' was the reply, 'to talk of what is utterly exploded! You ought to know that the best philosopher in Liverpool finished them off entirely when he squared the circle.' I stuck to my nuts and said nothing. The rest appeared to be convinced that James was beaten. I do not consider the gentleman who squared the circle answerable for the ignorance of John. My only intention in telling the anecdote is to introduce this remark, that, in my poor judgment, the philosophers who will hear of nothing in science but the counting and adding of sequences, progressions, coherencies, and correspondencies, are just as wise about the cosmos, as my friend John, who has never formed the conception of a ratio, is about what he calls the theory of numbers. Of course the philosophers can easily make the reply, "Oh! we deal only in general theorems; we have a rule never to investigate the relations of the cosmos to our conscious thinking selves." And truly there is a certain dignity in declining to do that. The cosmos has no right to expect that. That, you know, sir, would be personal!

I have had a long correspondence with an accomplished metaphysician about these notions of mine. He claims the victory mainly at this point, that I refuse to define for him in exact terms what I mean by my will-force. He demands my description of its unit and measures: he wants a pound of it, I fancy, to examine. I refuse to define it. I am bound either to define and describe it, or else to tell him, without ambiguity, how he may find my plain meaning for himself, as I find it. I refer him to the easy investigation that I have described, of the transition in consciousness from purely passive sensation to active effort. I say, you are on your easiest garden chair, quite in repose in the sunshine, not moving a muscle. Ask yourself, What is the condition necessary and sufficient, that I set myself to work? You know that nothing but main force can get you off that chair, and set you and keep you working for twenty minutes like a horse at that roller. Where is that force to come from? You know it must come into your consciousness only by and from your will. If you can set it agoing, then the state of your consciousness when you put it forth and sustain it, I call your conscious act and utterance of will-force. If you say that you find no fact in your consciousness, marking the transition from conscious inaction to conscious effort; then you and I cannot talk philosophy in this planet: we must hope to succeed better when we meet in Jupiter. I will not give you change in words for this term will-force, in much-abused words, that you may stretch and squeeze, and mar and muddle, in wrangle without end. Ask Hume, when he preaches about the sequence of desire and fulfilment in the movement of your finger, to give you an exact definition of desire. You won't get that bit of salt on his tail. Can you define consciousness or life? As to life, that seems rather easy: at any rate it has been done. You may find in the pages of one of our greatest living philosophers a discussion about the

definitions of life, and the right definition is actually settled! I have seen it. I should have been merry at the sight, if I had not been sorry to find myself in capacity so far below the ladies and the gentlemen who can admire such mosaic of black and white as deep philosophical thinking.

I have, I fear, been tiresome in the discussion of this first question—Can I demonstrate from this starting-point, I am and I know that I am a conscious thinker, any other being, conscious or unconscious, besides my thinking self? A far more important question is next to be considered. Can I demonstrate, without assumptions, that there is in the cosmos any finite conscious thinker besides myself? Or how can I pass, without assumptions, from 'I am' to 'Thou art?'

PART II.

Having demonstrated from the facts of consciousness the existence of an external cosmos made up to my perceptions, so far as they are definite, of forces in action in various loci, some in equilibrio, and others in motion, the most important of all to me being this locus which I call my body, I proceed to ask this question, Can I find and demonstrate, without assumptions unproved, the existence of any finite conscious thinker besides myself? Not that I am able to doubt for a moment that I am now in the presence of such thinkers. I say to every one of you, Thou art, with a conviction of certainty differing in no appreciable measure from my conviction that I am a conscious being. That you are verily before me as so many mere loci of force I can easily find with demonstration, as I can find that wall; for I can in a moment summon into my self-consciousness that familiar relation of conflict between my will-force and the force which I encounter in you. But this does not amount to a demonstration of conscious thought, either in your bodily locus or in the wall. Every one of you is to my passive and to my

active experience, a very mobile group of phenomena, and nothing more; yet I find myself affirming the presence in you of that which is never phenomenon to me, namely, of consciousness, intelligence, and will. Besides that which I know how to find by the test of my will, I am ever either assuming or inferring somehow in each of you something more, which I cannot thus exactly find. And as I am determined to admit in science nothing beyond but what I can demonstrate, I cannot be satisfied till I have either exploded the assumption, or formally proved the inference. It is very difficult for me to propose this problem as science in earnest to one with whom I converse in a common language. There is a round of mutual concessions and assumptions in the use of language which it is desirable to eliminate at this beginning of philosophy. Let me be a Crusoe in a desert island. Rambling there in my metaphysical ponderings, I meet one day my black Friday, with whom I have not a word of language in common. From the first I am quite certain that I am in the presence of self-consciousness, and of limited thought and will, as real as my own. But I can no more find directly in terms of my own either passive or active experience, that self-consciousness in him, than he can find mine. He is to me what I am to him, a bundle of sensible phenomena; and, assumption and inference being excluded, he is nothing more to me, nor I to him. Yet the inference is to me irresistible, in spite of my most determined scepticism, that there is indwelling in him a true personality and will, finite like my own, and of intelligence and power inferior to my own. I ask myself how I am as a scientific thinker to justify this inference without unproved assumptions. I do not justify my inference by saying that I cannot help making it. Such pleas as I must make it, — it must of necessity be made, — I utterly contemn. I will have in my philosophy none of your miserable must be's to fill up the

voids of though. Here I am, first saying to myself, This Friday is a group of phenomena which perpetually seem to indicate to my exact inspection a present and indwelling personal being having consciousness and limited intelligence and will: that is my datum after examination. Secondly, I find myself saying, Therefore, in this Friday there is a finite personal being, having such consciousness, intelligence, and will. But that is not reasoning. You cannot build a logical argument with two propositions. If my inference is sound, there must be a true general proposition producible, which shall complete the syllogism. I must produce this, or else abandon my pretence of philosophical thinking. I can write down more propositions than one, which will make a good syllogism. For example, thus: In all groups of phenomena associated with a human form, continual indications of indwelling conscious intelligence and will are also demonstrations to me of such indwelling. This Friday is such a group of phenomena, therefore his indications of such indwelling are to me demonstrations of it. But in the first premiss, the limitation to a human form is unscientific, because I am quite sure that if Friday had three legs, I should make still the same inference from the phenomena. This cannot be the major proposition of which I am in search. Let me try another without this limitation of human form. In all groups of phenomena which indicate continually the indwelling of conscious and imperfect intelligence and will, the indications are to me demonstrations of such indwelling. Friday is such a group of such indications. Therefore in Friday are to me demonstrations of indwelling intelligence and will. But the major term is unscientific, unless it be true that the validity of the indications of intelligence and will depends on their imperfection. If my knowledge or skill in any department could be enhanced to what is fit to be called perfection, would my indications to a

competent observer, supposing such a one to exist, lose their value as demonstrations by losing their imperfection? I will not waste your time on this, nor pretend to exhaust the number of assignable majors. I observe merely that the one required cannot begin with Some groups, nor with even All groups but one of the defined indications; for we should have the middle term twice particular, which destroys the syllogism. It must begin with All groups. And I venture to say that if my inference from the phenomenal Friday to the conscious and intelligent person Friday is a scientific one, there must be a perfectly general major proposition from which, or from an included case of which, it is concluded: and that major is neither more nor less than this—All groups of phenomena, which seem to me to be continual and consistent indications of conscious intelligence and will, are to me scientific demonstrations of the real presence and action of intelligence and will. By the group of phenomena Friday, I mean everything that I can observe in him, without recourse to assumptions or inferences. In studying the entire group, I am guided by what I know of the phenomena which I present myself to an observer, to consider as demonstrations of his finite personal being in consciousness only a limited number of the indications; not his colour nor his weight, but, for example, the signs of distress when he is hurt or hungry, and the various tokens of excitement, of purpose, of capacity or incapacity. It is from these that I draw my inference of his human consciousness. In doing this correctly, I must have at least this major: Phenomena which well examined by me, indicate the presence of an unseen human consciousness, are to me demonstrations of its presence with the phenomena. The phenomena which Friday presents are such indications; therefore the phenomena in Friday are demonstrations of his human consciousness. The major here employed is in brief, All well-examined phenomenal indica-

tions to me of human consciousness, are also demonstrations of it; so that from the seen I make by that major a scientific inference to the unseen. If I am asked how I prove this major, I reply that is a case comprehended in this more general theorem, —All continued and consistent phenomenal indications to me of invisible consciousness, intelligence, and will, are verily to me demonstrations of the unseen verities indicated. If next I am required to prove this most general proposition, I answer boldly, that it is a fundamental truth of reason, the denial of which is utterly absurd. Beyond that point I shall not pretend to debate. I leave it there; for wherever it is left, the appeal must be to the consciousness of rational thinkers. I do not here claim any formal logical triumph in this difficult topic over the gentlemen who consider this old inference from intelligent design and work to a conscious designer and worker, as unphilosophical. I am familiar with the style in which they contrive to amuse themselves at my expense. I have not said in vain what I have uttered, if I have drawn your attention more closely to what is involved in the enormous assumption which these gentlemen make at their starting point of the whole present tense of the verb to be. They say each man to the other, Thou art a conscious thinker, with the certainty due to self-evident truth. Each one when he says I am, expects the other to reply, Thou art, with a scientific conviction loud as his own I am. It would be a useful exercise of scientific thought, if they would try to construct a demonstration of this Thou art, which will satisfy an exigent scepticism like that which they are elsewhere so forward to display. I have pointed out what they will come to if they do try. They will have to write down as the only possible major of their demonstration, an enormous case of that implied general theorem which they are so many of them ready to deride.

It is possible that some of these gentlemen may decline

the attempt to demonstrate the truth, Thou art a conscious thinker, under the plea that they do not pronounce it as an absolute certainty of science. They may say, we make the assumption as a probable explanation of the phenomena, as we do in all our studies of nature; and we are satisfied with the verification of our hypothesis which experience supplies. But how can experience verify a supposition of that which cannot come into experience? And is it true that the conviction with which men say to each other, Thou art, is of the same order of certainty as this, The tide will flow to-morrow? We are not many of us ashamed to explain our meaning thus: The tide will flow to-morrow if the forces of nature continue so long in unaltered action. But when a man is looking into his brother's face, where can he find an if to qualify his confession, Thou art a conscious thinker? He can say, If I am not mistaken; and so he can after adding up ten times his butcher's bill. The brief continuation which I begged leave to read of my former paper you have now heard.

I shall trespass on your patience no farther with these old debates. Allow me to enunciate one little theorem which appears to me to have some metaphysical value. If you agree with me that this, I am a conscious thinker, is the first proposition in philosophy, and therefore, whether written down or understood, actually the first proposition in every train of reasoned thought, you will accept as a certainty of science this little theorem — I am a conscious thinker, can never be the final step in any train of reasoned thought. For if the first is also the final proposition, the fancied train of demonstration must be what is called a vicious circle, the most laughable of all blunders in logic. This disposes at once of all the pretences of our fashionable negation-philosophers, scientifically to evolve, as they call it, human consciousness. Every such feat is a fool's circle, beginning exactly where it ends. Vicious in English seems a hard word. A circle may

be foolish without being vicious. Would you like a promenade round such a fool's circle? Mr. Herbert Spencer will be happy to escort you.

I could offer you a similar little theorem about Will. Every pretence of our Evolutionists to deduce Will from the forces of the cosmos is a fool's circle; because no man can verify the present existence of any acting force whatever, but by beginning with 'I will,' and putting forth his conscious will-force. Only at the challenge of my free will, will any of these forces speak to my intellect.

The remainder of this Paper, if you have the patience to hear it, is a review of the stiff denial which this great thinker gives to every word that I have uttered from my beginning. I quote from § 179 of his *Psychology*, his grand demonstration of the development or evolution of consciousness out of the unconscious. You know he has invented a celebrated Evolution-machine. At one end is a vast tank in which he has the cosmos, every atom of matter and every throb of mind, all reduced to a perfect and lifeless pulp of purest homogeneity. He turns the handle, and away goes the pulp through all his rollers, and comes out at the other end a beautifully printed sheet of Mr. Herbert Spencer's *Biological and Psychological Evolution*, in which we are all to be found just what we are, body and mind, scientifically manufactured and finished out of the primary inert unconscious pulp. I am about to read every word of what I admire as the most brilliant of all his triumphs, the evolution of conscious out of unconscious life. "In other words, the advance of the correspondence, the development of consciousness, and the increasing tendency towards a linear order in psychical changes, are different aspects of the same progression. For how only can the constituent changes of any complex correspondence be co-ordinated? Those abilities which an intelligent creature possesses, of recognising diverse external

objects, and of adjusting its actions to composite phenomena of various kinds, imply a power of combining many separate impressions. These separate impressions are received by the senses—by different parts of the body. If they go no further than the places at which they are received, they are useless. Or if only some of them are brought into relation with each other, they are useless. That an effectual adjustment may be made, they must be all brought into relation with each other. But this implies some centre of communication common to them all, through which they severally pass; and as they cannot pass through it simultaneously, they must pass through it in succession. So that as the external phenomena responded to become greater in number and more complicated in kind, the variety and rapidity of the changes to which this common centre of communication is subject, must increase (now it is coming)—there must result an unbroken series of those changes (here follows one little dash)—there must arise a consciousness." That 's it; the whole evolution, the whole demonstration—the whole amazing revelation! How short, and how sublime! "There must arise a consciousness." The next Longinus, Sir, will take care to put that in before γενέσθω φῶς, καὶ ἐγένετο φῶς; for the evolution of consciousness is far more than the evolution of light. He knew he could do it; and he did it. *Plaudite porcelli!* Such knowledge was not too wonderful nor excellent for him: he has attained unto it. *Plaudite porcelli! Porcorum pigra propago Progreditur;* to wit, the sage and solemn theorems of Evolution!

Now, put yourself into Mr. Spencer's hands. You say at the outset—and you must say, if ever you begin—I am a conscious being; otherwise I could not be a conscious disciple of Mr. Spencer. He shows you that you are descended from a long line of conscious beings; he demonstrates in his fashion that your pedigree runs much higher, through races

of unconscious beings, right into the middle of the pulp of homogeneity; he proves to you how, by his differentiations and integrations of the pulp the first consciousness must and did arise by evolution in your pedigree; he demonstrates to you that this consciousness must be and has been by necessary law transmitted to you; and makes you draw the splendid conclusion: I must be, and *ergo* I am, a conscious being. To that position you have demonstrated your way from your starting point. You feel wondrously wise, as all philosophical ladies and gentlemen are sure to feel, now that you have been led by the nose round a fool's circle, which ends with the identical proposition with which it began. If you had thought of the old logical rule, that the first proposition in a train of demonstrated thought can never be the last, you might have saved yourself the trouble of the journey through all those millenniums.

This § 179 is an admirable specimen of Mr. Spencer's power, when you are so lucky as to be able to make out at what he is driving. He makes it quite clear, that the evolution of consciousness is simply a question of speed, viz., the rapidity of the internal changes as they go whizzing through the turn-stile which he has the wit to place in the centre of the unconscious organism.

He says, "The variety and rapidity of the changes to which this common centre of communication is subject must increase—there must result an unbroken series of these changes—there must arise a consciousness." One more in a second does it all. These *must be's*, how beautiful they are! 'There must arise'; 'there must result'; and they 'must increase'; 'they must pass through it'; 'they must be all brought into relation.' These *must be's* are the diamonds of Mr. Spencer's *à priori* thought. He scorns everything below diamonds. You talk of magicians and conjurors, of rainmakers and miracle-working priests; I

say that all their renown over all the religions of the planets is thrown into the shade by this achievement of Mr. Spencer, who has bridged the vast gulf between the conscious and the unconscious by one little typographical dash!

Here let me remark that I do not call every circle of thought a fool's circle. There are circles of investigation, of observation, and of verification, which are quite scientific, and the proper foundations for demonstration. If Mr. Spencer had given us *may be's* instead of *must be's*, and offered us his imaginings and conjectures instead of his demonstrations, I could not have charged him with constructing a fool's circle. His attempts at philosophy would then have gone for what they are worth, and the appreciation of their value would have been left to men of science. It is the sham diamonds with which he has decorated them which make his circles into such utterly foolish circles. The last word which he utters in his pretended evolution of consciousness is this—there must arise a consciousness. He knows enough about the philosophical requirements and acquirements of the public and the periodicals for whom he writes, to see that while the *may be's* might have passed for what they were worth, the *must be's* will go for a hundred times more than their worth.

I shall do injustice to my own argument if I do not place before you the denial which is given by the same distinguished philosopher, Herbert Spencer, to almost every word that I have uttered about *I am* and *I will*, and about the analysis of the facts of consciousness. He does not begin his Psychology with those. He takes a loftier flight into Mind in the abstract, Life and Consciousness in the abstract, Intelligence in the abstract; and only after ballooning in the clouds through nearly five hundred pages does he condescend to consider those antiquated institutions, the subsisting personal Ego, and the human Will. He devotes

eight pages to them; and I am very sure he would have been only too happy to have been excused from considering them at all. The surest way to abolish these institutions is to extinguish the Ego; for, that once out of existence, its supposed attribute, Will, vanishes of course. I shall quote only his very short Chapter IX., entitled, The Will. He begins as usual by showing his diamonds. The Will, says he at the outset, is *necessitated* by the same conditions as Memory, Reason, and Feeling; it *must be* exhibited just like them. In § 219 he thus describes the current illusion about the Will, and tries to kill it by killing the stronger illusion about subsisting personal identity on which it depends. We read, "Considered as an internal perception, the illusion consists in supposing that at each moment the *ego* is something more than the aggregate of feelings and ideas, actual and nascent, which then exists. A man who, after being subject to an impulse consisting of a group of psychical states, real or ideal, performs a certain action, usually asserts that he determined to perform the action; and, by speaking of his conscious self as having been something separate from the group of psychical states constituting the impulse, is led into the error of supposing that it was not the impulse alone which determined the action. But the entire group of psychical states which constituted the antecedent of the action, also constituted himself at that moment—constituted his psychical self, that is, as distinguished from his physical self." The dogmatic assertion without any attempt at proof, that the conscious psychical or mental Ego at any moment is simply the aggregate of states of consciousness at that moment, and the converse, that this aggregate of conscious states, "feelings and ideas," or again, "this composite psychical state" at any moment is the mental Ego at that moment, all this is repeated in many forms in this section, in positive and negative forms;

"psychically considered he is at that moment nothing more than the composite state of consciousness." There is no mystery in the wonderfully learned term psychical; although the quibbling distinction between the psychical and the physical Ego is very useful, no doubt. It is elsewhere defined that every state or change of consciousness, perceived in consciousness, is a psychical state or change; be it conscious sensation, conscious feeling or idea of any kind. Observe, first, that the vulgar notion of the Ego, that it has to these states and changes, to these feelings and ideas, the relation of subject to attribute or of subject to affection, is exploded. There is no relation between the psychical Ego of the moment and the psychical state of the moment, but the relation of pure identity. The Ego is identically the aggregate or group of states: the aggregate or group is identically the Ego: whether you speak correctly of your Ego, or of any other, you are bound everywhere to think rigorously this identity. Now as the aggregate of one moment is never the identical aggregate of the preceding or of the succeeding moment, for every change in visual perception changes the aggregate, what we call our conscious personal identity from moment to moment is a ridiculous fiction, and the loudest testimony of our inmost consciousness is a perpetual lie. That simply follows from these dogmatic assertions, and I shall not dwell upon it; my business is to examine the bare nonsense of the assertions, not to deduce the nonsense which richly flows from them. It will suffice to examine a single sentence, which I will read once more. Observe that the subject or nominative is '*a man.*' "A man who, after being subject to an impulse consisting of a group of psychical states, real or ideal, performs a certain action, usually asserts (observe that the *man* first-named asserts) that he determined to perform the action; and, by speaking of his conscious self as having been *something separate* from the group of psychical states

constituting the impulse, is led into the error of supposing that it was not the impulse alone which determined the action." Who is led into the error? Clearly the man who asserts, the man first-named. Now since to be led into the error of *supposing*, of supposing himself something separate, is a psychical state, the man first-named is a conscious psychical, that is, a mental *ego*, not a physical man who is merely seen walking or heard asserting. This psychical man is described as in error both in what he thinks and what he asserts about himself; but of course our philosopher can neither think nor speak but with the exactness of his own science. The philosopher speaks and thinks of 'a man who is subject to an impulse consisting of a group of psychical states,' and the man is a psychical Ego. Let E denote this Ego, and let G denote this group of states. Now at the moment of the consciously received impulse, E is by Mr. Spencer's definition identically G; and his conception of the fact of that moment is that G is subject to and conscious of the impulse G. But since the receiver of an impulse must be there to receive it, Mr. Spencer's thought seems to be that G feels itself kicked by G before G is either kicked or born. Was that verily his thought? No. I venture to say that both in this place, where he speaks of a psychical Ego, which is the subject of an impulse G, and lower down in the same section, where he speaks of an Ego which is "the subject of such psychical changes," he is thinking, as he is speaking, of a subject mental Ego, that is, something separate from the group G, which G is in one place the impulse, and in another the psychical changes to which the Ego is affirmed to be subject. And you all see, if he be thinking at all, and not merely pushing about a set of empty symbols in a sort of thimblerig of words, that he is conceiving what he cannot help expressing, that the psychical subject E is not identically G, but something separate

from G. And where is the harm of that? Simply that Mr. Spencer goes on to censure the blunder of this thinking Ego in "speaking of his conscious self as having been something separate from the group of psychical states constituting the impulse." The harm is merely this bit of precious nonsense, that, if Mr. Spencer is thinking, and not thimble-rigging, he is committing, in spite of his dogmatising, the very blunder which he censures: and he cannot help committing it.

I shall not poke farther into this scientific muddle. Every thinking reader must judge of the nonsense for himself; and he may multiply it by ten, if he chooses to compare the Ego of this § 219 with the account of consciousness proper in § 180, where it is not a group at all. At your leisure you may study this identity, "an impulse consisting of a group of psychical states;" and try to find out how 'impulse,' something dynamical and active, can be equivalent in scientific definition with 'state,' something statical and passive. And you will be pleased to see how, in this juggle of incongruous words, all reaction and contrast have disappeared, because it has gone through the rollers, and all comes out so smooth and flat, you know.

The distinction between active and passive experience, which was made in my preceding Paper from our study of consciousness, does not suit these scientific gentlemen at all; for it involves those hard and knobby things, subsisting personal identity and will. These things do not pulp properly; they must be got rid of, or the cosmos cannot be simplified, so as to slip nicely through the evolution-machine.

I think the funniest of all their pretences about your consciousness and mine is this: that when you are rowing or running for your life, or forcing your way with all your might through a crowd, you are just as purely receiving

impressions by their ingenious and convenient invention, the muscular sense, as you are when you sit at perfect rest, and receive by your nose the salutation of their learned pipes. When, instead of your old five senses and your will-force, you are furnished with six automatic senses, and all real distinction of active and passive is abolished, you pulp and go through the rollers, you know.

Here you may well ask, Is there nothing in this section (§ 219) besides the dogmatic assertions that you have quoted, with their decorations of absurdity—is there nothing like argument for the demolition of subsisting personal identity? I am happy to say there is one, though but one, argument: it is only a little one, and you shall have it, word for word. We read in this same section: "Either the *ego*, which is supposed to determine or will the action, is present in consciousness or it is not." That is promising, and looks like close quarters; that is verily the way in which a good reasoner opens an exhaustive argument. He goes on: "If it is not present in consciousness, it is something of which we are unconscious—something, therefore, of whose existence we neither have nor can have any evidence." That, you say, may pass for true, if it is not very profound. Let me entreat your attention to the remainder. "If it is present in consciousness, then, as it is ever present, it can be at each moment nothing else than the state of consciousness, simple or compound, passing at the moment." You all seem puzzled. I will give him a fair chance; I will read it slowly again from the beginning. You are bothered still: you ask me whether there is not some printer's blunder in the third part; the very question I should ask if in your place. I confess that it would sound like sense to me, if it stood thus: If it is present in consciousness, then, as it is ever present (not fleeting and passing at the moment), it cannot be merely the state of consciousness passing at the

moment. To my faculties, that would appear to be sense; but I assure you that the very contrary is what is read here, and it is impossible to reduce it to a typographical error. These are the very words: "If it is present in consciousness, then, as it is ever present (not passing at the moment), it can be at each moment nothing else than the state of consciousness, simple or compound, passing at the moment." How can the fact that it is ever present and not passing be a demonstration that it is nothing else than what is passing at the moment? To all the wits I have, this is deplorable nonsense. And if it were sense, where is the argument that he promised us in that logical flourish at the beginning? He wants to prove to us that the *ego* is nothing else than the state of consciousness passing at the moment. And he proves it simply thus, by shouting out louder than before, "it can be nothing else"! To me it is helpless, hopeless nonsense all.

Here we see what a figure Mr. Spencer cuts, when alighting from his balloon he tries, what he does not attempt once in three hundred pages, to go in to a definite position on solid ground, and handle his logical weapon at close quarters. He seems dreadfully puzzled about which is the right and which the wrong end of it!

This subsisting personal Ego is yet unslain. Mr. Spencer is not to be indicted for manslaughter; and that provoking enemy, Will, confronts him as before. I must give you a clear account of his campaign against Will. His arguments against me have ten times the force in my favour of my own, which is mainly an appeal to your consciousness. I hope that you will not find your patience abused, by a full statement of my opponent's position. He treats first of my subjective illusion about my own will; next he gives the most wonderful illustration of my objective illusion in attributing a free will to you; and finally he loses patience

with our stupidity, and takes his revenge by impaling himself without mercy. He and I quite understand each other, both about the facts of volition and the names of them. He does not dispose of my will as he does of my subsisting personality, by simply wiping it out of existence. We both affirm that we perform voluntary and involuntary acts. We agree that there is will or volition in every voluntary act. But he knows, and I do not know, how to evolve, to analyse and thoroughly to expound Will. All that I can say is this: that in my voluntary act I freely originate and contribute, at my special choice and expense of effort, an initial something which I call my will in act or my will-force; and I affirm that I am conscious of nothing at all so contributed by me at my choice, in the changes of my passive and involuntary states. But this bold antagonist assures me, with what sort of logic you shall speedily see, that in both these states which I call active and passive, I am always neither more nor less than a process and sequence of inevitable changing groups, and that my notions of my choice, my originating or contributing anything more of action in one state than another, is a foolish and perpetual illusion. He informs me that all my changes are absolute necessities of adjusted relations, which he can express by his *must be's*; and he is of opinion that I ought, like him, to watch them calmly and philosophically as something going on under my mere inspection, just as my changes of temperature go on. But as he is compelled to allow that in my consciousness of voluntary act there is a certain real fact which I blunderingly claim as my special contribution of choice and force, he is bound to do what he greatly dislikes, to confine his remarks to this one precise fact. I know it quite well, says he; I, too, call it will or volition, which are the same thing. I cannot undertake to put you in possession of the exact import of the terms which he employs. I am convinced that

he and his admirers are familiar with dozens of long words in -eity and -ality and -ility and -ivity and -ation, about whose definitions they seldom trouble themselves; especially those imperial terms, the differentiation, and the integration, and the co-ordination, and the re-differentiation, of the simultaneities and the serialities, of the progressions, the coherences, the relativities and the correspondencies. Why in the world need they trouble themselves? Those long-tailed abstracts know how to take such good care of themselves; you may knock them about in heaps as you please; they never fail to tumble up as clear and perfect as when new from the mint, and at a glance you can distinguish them and swear to them again. Time enough to bother yourself about exact definitions, applications, and verifications, when you have finished philosophising in general. I never saw a book in any language of which the readers are more likely than Mr. Spencer's are to profit splendidly by the Devil's advice to the Student in *Faust*:

> "Halt fest an's Wort:
> Mit Worten laesst sich trefflich streiten;
> Mit Worten ein System bereiten;
> An Worten laesst sich festlich glauben;
> Vom Wort laesst sich kein iota rauben."

In § 218 we find the genesis or evolution of volition out of automatic action. The most oracular form of the dogma is given thus: "The cessation of automatic action and the dawn of volition are the same thing." Hear with faith and reverence this evolution in § 218 of Will. "When the automatic actions become so involved, so varied in kind and severally so unfrequent, as no longer to be performed with unhesitating precision—when, after reception of one of the more complex impressions, the appropriate motor changes become nascent, but are prevented from passing into imme-

diate action by the antagonism of certain other nascent motor changes, appropriate to some nearly allied impression; there is constituted a state of consciousness which, when it finally issues in action, displays what we term volition." You need not try your powers upon anything more than the concluding sentence, "there is constituted a state of conciousness, which, when it finally issues in action, displays what we term volition." Let the state of consciousness be called C, let W be the displayed will or volition, and A the action; then C W A is tho combination, namely, a state of consciousness C, which displays will or volition W, when it issues in action A. Observe that nothing comes between C and A except W, for C is said to issue or end in A, at that moment displaying W, which of course precedes A. You may now ask, without disturbing your conception of the facts in their order: What is the state C of consciousness? The answer is clear from the preceding words: "When the appropriate motor changes become nascent, but are prevented from passing into immediate action by the antagonism of certain other nascent motor changes appropriate to some nearly allied impression, there is constituted a state of consciousness," namely this C. Whatever else is dark, one thing is clear, that C is a state of conscious antagonism between the appropriate changes and certain others not quite appropriate. If you can lay hold of this character of conscious antagonism in C, you have the pith of the matter. Hear this more distinctly in the next sentence but one. "We have therefore a conflict between two sets of ideal motor changes, which severally tend to become real, and one of which eventually does become real; and this passing of an ideal motor change into a real one, we distinguish as Will." The conflict spoken of is the state C of consciousness, in which we distinguish one ideal motor change as it passes into action A, thus becoming a real change, from the

other conflicting ideal changes which do not become real. And this act of distinguishing, I fancy, he points out to us as W our Will, which we are so foolish as to imagine something more than a mere note of observation. You have heard now the evolution, and every word that I can find of its proof. This genesis of Will is far from being so bold and dashing as the evolution of consciousness. Mr. Spencer does not enjoy his topic at all. He is afraid of it. Volition, 'what we term volition,' is once named, as something which at a vanishing moment is *displayed*. Will, the same fact, is once pointed to as something about which *we distinguish*. No more; he touches it delicately; he is as gentle and as cautious as a Bishop: and if he were a Bishop, we could hardly be left more in the dark about his Lordship's positive ideas on the subject. But you are about to see that he lets out quite enough for my purpose.

The formula CWA is thus obtained by triumphant evolution, as the chemico-physiological equivalent for all and every voluntary action. The reasoning is perfectly general, covering every action in which Will is conceivable. When all is unhesitating precision in the changes, we are told, the action of the conscious organism is automatic, or void of all volition; and it is only by virtue of the antagonism and conflict among the nascent motor changes that Will or Volition can arise. Calling C consciousness of conflict, the law is, no C no W; and if there be no W, no will, the action is automatic and not voluntary at all. Thus we can compare the evolution of will with that of consciousness. Consciousness was evolved in the unconscious organism by a continual rush of changes through the central turnstile. So long as it is an unhesitating rush, it is automatic life and action in the conscious organism. But for volition we must have more than rush; we must have a lock and a choke, and in fact a row. That row is the evolution of will. How-

ever swiftly the motor changes press through peaceably, all is automatic; there is no volition till they begin to collar, to cuff, and hammer one another. Does any body ask for proof? When Mr. Spencer by the study of Mind in general has found this out, and says it, and so many philosophical ladies and gentlemen stick to it, do you demand proof? I say it proves itself. How can there be conflict and cuffing without the evolution of voluntary action?

I have now only one little sentence more to read, which follows next on what you have heard. The appeal is there made to what we find in consciousness, by way or confirmation of this evolution of will. Thus: "In a voluntary act of the simplest kind, we can find nothing beyond a mental representation of the act, followed by a performance of it." We can find nothing, says he, but a mental representation R, followed by a performance of it P. R P is all that I find in this voluntary act. I accede to that, provided that I am allowed to find my will-force there; and P cannot be the performance of a voluntary act A, unless it has the form WA. Making that substitution, which is evidently just what Mr. Spencer means, while allowing to him of course his own conception, if he has one, of the meaning of W, we have RWA for the new equivalent of any voluntary act of the simplest kind. And the theorem now is that we find by consciousness nothing more in any such voluntary act. I am quite willing to confess, that in moving my finger, swallowing my food, which is, I fancy, the oldest voluntary act in all my pedigree, or in feeling my lips with my tongue, or in more complex acts, such as clambering over a stile or mounting my horse, I find a state of consciousness R, the representation of the coming act A, my will-force W, and the act A itself; and that is probably about all that I observe or remember. These two formulæ or equivalents for the same voluntary act, one obtained by evolution, and the

other from Mr. Spencer's own inspection of consciousness, must be identical, supposing that our philosopher is not amusing himself by talking nonsense. That is, RWA = CWA, which is impossible, unless R and C are exactly the same state of consciousness proximate to will. But R is by definition rigorously nothing but the mental representation of the coming act A, while C is by definition that and much more, viz., a state of conflict in consciousness between the idea of A, and the idea of some act not performed. C is defined as an antagonism, and next as a conflict between two sets of ideal motor changes, which severally tend to become real, and one of which eventually does become real. Thus the state of consciousness which issues in voluntary action *is* only, and *is not* only, the mental representation of the coming act. *Ergo*, facetious Mr. Spencer &c.; Q.E.D.

Permit one word concerning the automatic action and the spontaneity, about which our physiologists and psychologists write so learnedly. I do not believe a single word of what they say about the transformation of voluntary into automatic, and the converse. They tell us how the child at the breast is sucking and swallowing automatically. How am I to find that out? How did they find it out? How do they know that, if they could remember their own sucking and swallowing at the breast, it would not be exactly the memory of volition? That sort of science will not suit a sceptic like me. They tell me how they walk automatically, while conversing or pondering, and how the young ladies play the piano automatically, chatting vigorously all the time to them—happy fellows! Where do they get their demonstration? I believe it is merely a blundering inference from the blanks of memory. A voluntary action which occupies a second, say the execution of a musical phrase, and which is by repetition very easy and habitual, may possibly be commanded by an act of volition that occupies the thousandth

part of a second, and which leaves a trace in memory that is instantly effaced by the occupation of the huge remainder of the second.

Before I pass to the gorgeous illustration which I promised you of the blunders of free-will, I ought to notice the only allusion which Mr. Spencer makes to the statements of his antagonists. His allusion is simply a very old and a very easy misrepresentation. I do not say it is a wilful misrepresentation. He puffs it out, in his mighty cloud, all about the confused conceptions of other people. His words are these, in § 219: "That every one is at liberty to do what he desires to do (supposing that there are no external hindrances), all admit; though people of confused ideas commonly suppose this to be the thing denied. But that every one is at liberty to desire or not to desire, which is the real proposition involved in the dogma of free will, is negatived as much by the analysis of consciousness as by the contents of the preceding chapters." He pretends that my real proposition, when I assert my free will-force, is, that I am at liberty to desire or not to desire. To his unproved assertion I oppose my distinct contradiction of his words, along with my appeal to the consciousness and the conscience of every one of you; for on this topic conscience is as loud a witness as consciousness, if this were the place to call on her. I content myself with repeating what I and others have often said before, although it does not suit the purpose of these simplifiers of the cosmos to hear it or to answer it. I know and I admit all that Mr. Spencer can enumerate of the urgency of motives, arguments, and desires. It is a simple untruth to say that I really maintain only that I am at liberty to desire or not to desire. But this I say, that no arguments, motives, or desires whatever can issue in my voluntary act, but on two conditions; first, that I freely choose the time, the manner, and the measure of force for

the performance of the act; and, secondly, that I freely put forth that will-force which sets in motion for the act these instruments which are placed under the command of my will. I know that I have no proof to others of this beyond this old appeal to you, Γνῶθι σεαυτόν. We are luckily not all bound to begin our philosophy in Mr. Spencer's balloon. That human will is not simply a movement of appetite or desire, was shown not long ago by an example of supreme and terrific force, when a criminal, under sentence of death by the hangman, chose to die of hunger and thirst: he willed it, and he did it, in spite of all human efforts to prevent him.

You shall be rewarded now for your patience by the sublime illustration, and next by the still more awful self-sacrifice. In § 219 we are thus made ashamed of our objective illusion when we talk of each other's freedom: "The irregularity and apparent freedom are inevitable results of the complexity; and equally arise in the organic world under parallel conditions. (Note that, parallel conditions.) To amplify an illustration before used: A body in space, subject to the attraction of a single other body, moves in a direction that can be accurately predicted. If subject to the attractions of two bodies, its course is but approximately calculable. If subject to the attractions of three bodies, its course can be calculated with still less precision. And if it is surrounded by bodies of all sizes at all distances, its motion will be apparently uninfluenced by any of them: it will move in some indefinable varying line that appears to be self-determined: it will seem to be *free*. Similarly, in proportion as the cohesions of each psychical state to others become great in number and various in degree, the psychical changes will become incalculable and apparently subject to no law." That seems to stick together; there is a definite thread through it, which is more than I can say for scores

of pages of Mr. Spencer's integrations of what he calls coherences. Mr. Spencer has had a point in his eye, and has gone pretty straight to it. And the illustration, considering that it does not illustrate anything, is original and ingenious. He has evidently heard that the problem of two mutually attractive bodies moving in space has been completely and generally solved; also that the mathematicians are beaten hitherto in their attempts to solve in the same way the problem of three bodies. And he is quite right in saying that they have less notion of the general solution of that of four or more bodies attracting each other. Thus then he begins: perfect accuracy of prediction when there are before us two bodies only; less accuracy for three; still less for four, and so on; so that if, says he, to make quite sure, I surround the moving body with others of all sizes at all distances, the error of prediction will be unlimited, the body's path will be quite undefinable; it will seem free, and free will is floored for ever. Hurrah!

Observe that this is science: "surrounded by bodies of all sizes at all distances." Then at one-tenth or one-hundredth of an inch from the body in space there is somewhere a body of every size. That is puzzling. He chooses to speak of a moving body which cannot move. Why not? He who has abolished the gulf between the unconscious and the conscious; who has wiped out the difference between personality and personal experience, between subject and attribute, between active and passive, between dynamical and statical —why should not he, if he thinks fit, expunge the distinction between motion and rest? But perhaps he will forgive me, if I condescend to your infirmity, and make a little room for the poor body to go. Instead of *all*, I will put *innumerable*, and read it again. If it is an error of the author, it is only *all* for *some*, *all* for *not all*, twice over. A moving body in space so surrounded, says he, will have a path

undefinable: it will appear self-determined: it will seem free. We are all bound to accept Mr. Spencer's statement of his view of the phenomenon, as of something free and self-determined. He does not inform us to how many nor to whom it seems free; but he is sure that such is and inevitably will be the appearance of the thing. Nor can we doubt that he is aware that the moon is rigorously one case of his general supposition, coming exactly under the description in every point. It is a body, a body in space, surrounded by innumerable other bodies at innumerable distances. There are scores of them in our solar system, and millions beyond it, every one of which contributes something to the moon's motion. Our Milton loved—

> "To behold the wandering moon
> Riding near her highest noon,
> Like one that hath been led astray,
> Through the heaven's wide pathless way."

But his view of that lost moon, so wandering free at her innocent will, was obtained only in a passing moment of fine poetic fancy. Mr. Spencer gets that highly imaginative peep every time he looks at her, and talks of it in his philosophy as a thing of course and of necessity. You remember, Sir, the old gentleman in the French play, who was so wonderfully pleased to learn that he had been talking prose all his life without knowing it. O the rapture there is in store for Mr. Spencer, if ever he finds out that he has been talking poetry without knowing it! His very prose is poetry!

I think it very marvellous that nobody ever informed this poetical and positive gentleman that the moon does not seem free one bit, that she does not appear self-determined, that she is not rambling in any undefinable varying line, that her motion is not apparently uninfluenced by any of the othe

bodies; although he has actually written and printed about her and every other planet all these incredibly foolish things. Her movements are computed and predicted with a refined accuracy, with all the accuracy required within the limits of human observation and appreciation. The same thing is true, or can be made true by a certain amount of laborious registering and figuring, of every other body in the system. In spite of the difficulties of the general problems, which aim at solving all possible cases at once in *a b c*, our astronomers have methods, effectual for the needs of theory and practice, of dealing with the given system under their inspection. Nor do I believe that there is a group of associated bodies in the cosmos, which can be observed by human eyes, of which a thoroughly correct account would not be given, if our Astronomer Royal could get a ride upon one of them long enough, with his staff and his instruments, and with free access to what stations he chose. I say it is marvellous that none of those learned ornaments of the fashionable super-positive-negative philosophy, who are all so proud of Mr. Spencer, has had the kindness to prevent him from publishing a second edition of this accumulation of sublimely comical blunders,—publishing them in the most solemn and important chapter of his two volumes of *Psychology*, that upon Will, and, what is more, reproducing them in the only section of that chapter, § 219, which contains anything that pretends to be an argument. This huge mare's nest is his only argument, besides arrant dogmatism, good enough for stuffing a Theological Chair.

The funny muddle here made is very much like that of one who, having heard that mathematicians cannot solve the general equation of the fifth degree, should jump to the conclusion that they cannot find accurately the roots of such an equation. The truth is, that if to the co-efficients *a b c d e* you give any numerical values that you please,

thus presenting to us a definite single case, instead of all cases at once, we can find all the roots to any degree of accuracy, to a hundred decimal places, if required. And the same thing is true of every algebraic equation of any degree; they can all be solved, if the co-efficients are numerical, with unlimited approximation: and you can effect nothing more in the solution of a quadratic, if you demand a numerical answer; for it is millions to one that the root is incommensurable.

This illustration of Mr. Spencer's is the most astonishing that ever decorated a book of science. Even when, by the erasure of that masterly *all*, we have rescued it from stark mad lunacy, every step is a tumble, every assertion is another hobble, and from the first learned blunder to the conquering climax which routs free will for ever, it is altogether the most tremendous fun of rollicking muddle and misrule. It has been said, and it has been sung, Sir, "What a pity when charming women Talk of things which they don't understand." We are bound, as good Christians, to feel equal compassion for charming philosophers.

The first blunder is this: "A body in space, subject to the attraction of a single other body, moves in a direction that can be accurately predicted." It is true that the general expressions for the required variables are exactly known. But there can be no accurate prediction about such a body without numerical computation; and the only possible result of that will be an approximation, since every formula contains incommensurables. The accurate prediction of which he is thinking, and which he asserts, namely, something more than approximation, is impossible. Thus the first assertion is untrue; and equally untrue is every word that follows in the building of this stately argument, to show that the accuracy of the attainable approximations diminishes in proportion to the increase of disturbing bodies.

The motion of the moon in the presence of all those countless disturbances is predicted with all the accuracy that human eyes can appreciate; and that accuracy can be enhanced, if it is required, by known methods.

Judging equitably, from the evidence before me, of Mr. Spencer's notions about exact science, I think it highly probable that the prediction of which he knows so much in the case of only two bodies in space, is in his opinion a mighty simple achievement compared with his discoveries about Evolution. I fancy that it may be useful to him and to his admirers to get a glimpse of the notions of those who have really been taught to put a clear meaning into his favourite grand words, differentiation and integration. I say, that to find the relation between the place x and the time t from the origin of motion, of a body gravitating in a right line towards a centre of force,—to say nothing of the sublime achievements of Newton in the theory of elliptical motion,—I say that the solution of that simplest problem of rectilinear movement is incomparably a greater exploit of human wit and genius than all the biologies and psychologies now in the world, or likely to be seen in it for a century or two to come. I would rather, I would a hundred times rather, have the glory of constructing, upon the ground-work of simple arithmetic, that apparently easy solution, comprising as it does all that elegant analysis and faultless reasoning, with those millennial accumulations of victorious thought and magnificent invention, than have the credit of all the demonstrated brain-work that Mr. Spencer, with any five hundred Biologists, Psychologists, and Evolutionists to help him, could accomplish in the longest lifetime.

Glance now for a moment from the illustration to the thing illustrated. It is what he calls our 'objective illusion.' He says, "The actions of other individuals, lacking as they do that uniformity characterising phenomena of

which the laws are known, appear to be lawless—appear to be under no necessity of following any particular order; and are hence supposed to be determined by the unknown independent something called the Will." Is it true that this illusion is upon you and me? Do we 'hence' ascribe Will to each other, that the phenomena are not uniform? When we watch the leaping banners of the Aurora Borealis, of which the law is quite unknown, do we straightway invent the solution Will? I think not. We say to each other, Thou art as I am, a thinker; Thou hast as I have, a will; and we say it for reasons even more convincing than the conclusions elsewhere of science. Mr. Spencer has wittily invented this objective illusion of mere lack of uniformity, for the sake of his shining illustration. It is a usual device of common-place writers to build antagonist giants, which they forthwith knock down again with great applause. Mr. Spencer is not a common-place writer. He builds an antagonist dwarf, which straightway knocks its maker down.

Now for the tragedy of self-immolation. This short chapter of eight pages on Will cost more philosophical sweat than all the two volumes. The author gets himself into a heat, he runs himself into a corner, and brings himself dangerously to bay. Hear him in his final § 220. "To reduce the general question to its simplest form: psychical changes either conform to law or they do not. If they do not conform to law, this work, in common with all other works on the subject, is sheer nonsense; no science of Psychology is possible. If they do conform to law, there cannot be any such thing as free will." Here you see the horrible alternative. If you assertors of free-will refuse to commit suicide, you must endure the infinitely greater pang of seeing Mr. Spencer hurl himself and his books into that yawning gulf, a sacrifice, long devoted, and now by pitiless Fate consigned, to the abysmal gods of nonsense. Then

pitch him down, say I. Shall I spare him who tells me, and as you have heard prints it, that my movements in this orbit of conscious thought and responsibility are under 'parallel conditions' with those of yon driven moon? Shall I spare him, who has juggled me out of my Will, my noblest attribute; who has hocus-pocused me out of my subsisting personality; and then, as a refinement of cruelty, has frightened me out of the rest of my poor wits by forcing me to this terrific alternative, that either the testimony of this Being, this Reason, and this Conscience is one ever-thundering lie, or else he, even he, has talked nonsense? He has talked nonsense. I say it, because I have proved it. And every man must of course talk nonsense who begins his philosophy with abstracts in the clouds, instead of building on the witness of his own self-consciousness.

In the last words quoted there is, as you have well shown, Sir, sophism in plenty under his figure, 'conform to law.' I affirm that my will is under law, and yet that my will is free. It is under no law that he can formulate with his pitiful *must be's*; no law that fastens me, this accountable thinker, to these external cosmic changes. I am a free force among these forces, a conscious cause interfering with these sequences. For the grand new dogma of the Persistence or Conservation of Force I cannot find, and I would thank anybody to show me, half the proof that there is for the Pope's infallibility. A mere list of dogmatising names is poor proof. The law of my will connects me unsearchably with the Infinite, not through these forces which my will alone reveals to me, but in another line, with the Eternal Conscious Cause from whom I spring. I say connects me unsearchably, because I cannot read that connection up to the Infinite; but honestly and humbly reading in this finite where I stand, I formulate thus to myself, not without light which comes not from these phenomena, the law of my

accountable being: first, I ought, not merely I had best, I ought to do right; secondly, if I choose to do wrong, as I am perfectly at liberty to choose, I must (and when I say to myself I must, I am not pretending to teach you cosmical science), I must face and endure the consequences. No priest, no preacher can come between me and the justice and mercy of that law.

Of Mr. Spencer in person I have not the honour to know anything; of Mr. Spencer as a reasoner, whose praise is in all the Dailies and Monthlies, and rapidly increasing, I am sadly disappointed to know so much. In the direct line of my own topics I have spoken of his book; and I think I have made one thing clear, that although the gentleman may be competent for the evolution of a cosmos or two, he is not the man who will help us to lay the foundations of a philosophy without assumptions.

One word more. The question of free-will is everywhere tabooed. It is impossible, men say, to debate that. And the assumption is, that the arguments against it, if fully stated, are absolutely unanswerable. I, too, stand here to affirm that they are unanswerable. They fall exactly into two classes. One is, the *must be's*—the mere *must be's*—not *must follow*, of the Necessarians, the Positivists, and the Materialists. Do you expect me, a sceptical lover of science, to answer those? I kick them out of my sight. That is the scientific use of such windbags. These *must be's* are more offensive to my intellect than the warring dogmatisms of the churches. They do not indeed consign me as the theologies do to—I won't say where; but they make one sickening pretence which the churches never make; they pretend to be talking science. I say again, they are merely the rags which hang not sweetly on the shivering flanks of Ignorance. I spurn them from me. That makes room for real verifiable facts and for logical inductions. The other

class is, the demonstrations of those worthy men who are so learned about the nature and connection of the Divine attributes, the sages who comprehend the incomprehensible. Forsooth they have soared away to the infinite, and studied the matter there; and they come back to inform us how we all look from that end. I never mind them. They have not been at that end. My science is all at this end, in the finite. All their wise deliverances about this matter are liable to this fatal objection of logic, that they are propositions containing the Infinite. Do you expect me, a sceptical mathematician, to answer those? In mathematical science such propositions frequently present themselves, and we know how to deal with them. We lay them aside. We never allow one of them to be a step or a starting point in our reasoning. There is no end to the absurdities which we could demonstrate if we employed them. And they are of no more value in any other science of the finite than in mathematics. Every proposition containing the Infinite is, in the sciences of the finite, an instrument of sophism. I find that all the arguments which timid thinkers hold to be so enormously cogent against free-will, and before which, forsooth, Conscience and Self-consciousness are to be shamed into silence, are of these two inadmissible classes. I think that I have given good reason for contemning them all.

Yet I, too, know how to make for myself propositions containing the Infinite: they are but few, and I do not like to call them Science; but they have an evidence, a beauty, a power and a majesty, they have an inspiration and a consolation, unknown to the theorems of the Science which I love. A life of mere intellect were to me in this planet a life not worth living. My vocation in this world is to learn, to live, and to teach a nobler life than that. I can find my way into two kingdoms of thought. In one I am a bold enquirer and a sceptical reasoner, on all propositions of

saints or sinners about the finite of the present or the past. In the other, where I love to wonder and to exult about the Infinite, the Unseen, and the Future, I glory in being a believer, a thanksgiver, an obeyer and a worshipper. And the only firm foundation stones, from which I can walk into the one, or essay to climb into the other, are these: I am, I ought, I can, and I will.

P.S. Partly for brevity, and partly of wicked purpose, I have left open two or three little traps, into which the very sharp reader is intended to fall. Thus, against my charge of circular reasoning, such a one can easily cover himself thus: When I am philosophising about you, and evolving your consciousness, my first proposition, as you correctly affirm, is—I am a conscious thinker; but my last is—thou art a conscious thinker: and that assuredly is no circle. Yes, my clever friend, you lie quite snug there!

LANDSCAPE-PAINTING IN ENGLISH POETRY.

BY H. H. STATHAM, JUN.

ONE of the first philosophers of the present day, in re-stating the well-known theory of Berkeley, which denies to matter any but an ideal existence, has defined matter as *a permanent possibility of sensation.* "I believe," he says, "that Calcutta exists, though I do not perceive it; and that it would continue to exist if every percipient inhabitant were suddenly to leave the place, or be struck dead. But when I analyse the belief, all I find in it is, that were these events to take place, the permanent possibility of sensation which I call 'Calcutta' would still remain."*

To a defender or disciple of the philosophy whereby temples, towers, and even the great globe itself, are thus dissolved into the baseless fabric of a vision, it might seem not the worst presumptive evidence in its favour, that the references to external nature by writers of different periods indicate views of the same, and feelings suggested thereby, so distinct and diverse from one another, that it is sometimes difficult to believe that the authors of such descriptions could have been contemplating a permanent and fixed spectacle independent of themselves, and remaining the same from age to age; difficult even to realise what aspect the earth may have had for men of earlier generations. And it might be further urged, as confirming the idealistic theory, that as the intellectual history of man seems in the main to establish the fact of a progressive development of his mental

* Mill's *Examination of Sir W. Hamilton's Philosophy.*

powers and faculties with the growth of time, so that branch of ideas which the vulgar term "natural scenery" has developed in a similar ratio, insomuch that modern writers appear to be conscious of, and hold familiar converse with, beauties of the very existence of which there is not the slightest hint in the writings of men of the same relative calibre in earlier times. One of the most striking instances of this is perhaps the fact alluded to by Humboldt (in the chapter on Landscape, in the second volume of his *Cosmos*), that no description of the grandeur of Alpine scenery has been transmitted to us from antiquity, although, as he observes, "Roman statesmen and generals, with men of letters in their time, continually passed through Helvetia on their road to Gaul. But their only observations with reference to the country are comprised in complaints about the wretchedness of the roads, and the difficulty of travelling." *

And if, from the intellectual history of mankind at large, we turn to contemplate that of our own country in particular, we find this phenomenon of the varied, and in the main progressive, interest in Landscape at different periods scarcely less marked, especially when we consider it as exemplified in the poetry of the various periods of our literature. For it is here that the progress and development of feeling in regard to such a subject can be most clearly traced, seeing that all true poets are representative men, oracles through whose lips are uttered the best and deepest ideas that are current in their day; that they give expression to that which others, though in a lesser degree perhaps, feel but cannot express; and that it is from the poet of the age that we may best

* In the first chapter of Mr. Leslie Stephen's interesting and pleasantly-written book, *The Playground of Europe*, the subject of the rise and progress of interest in Alpine scenery is very fully gone into, and illustrated by a number of quotations from English and French authors and travellers for about one hundred and fifty years back. The whole chapter is so generally confirmatory of the view taken here, that reference would certainly have been made to it had the writer been acquainted with the book before this Paper was read.

learn what manner of sermons the rocks and running brooks held forth, what tongues were in the trees, for the most thoughtful men of his generation. This is the primary, what we may call the philosophical or psychological, interest to be derived from a study of the references to landscape in poetry. But there is a secondary interest, of another kind, to be found in the manner in which the poet endeavours to set landscape before us, the degree of success with which he is able, through the medium of language, to bring the impression of the scene before our mind, and awaken in us the same feeling which it inspired in himself. And the nature of this interest is obviously artistic. It is here, then, that we come upon the ground of analogy between poetry and another art, from which we borrow a term, and may speak not incorrectly of "Landscape-painting" in poetry.

Under this term, however, it is by no means intended to include mere versified descriptions of scenes, in all their detailed incidents. Such descriptions, in verse however polished and well turned, do not come under the head of 'poetry' at all; they want the glow of imagination and feeling; they give us only dry facts, which might be as well stated in prose, and would be much more clearly rendered by the painter. And so much has the landscape painter's art been materialised of late; so generally has the theory been preached and accepted, that his main efforts should be directed to the attainment of accuracy of imitation, and truthful representation of details; that it requires some degree of courage to assert that the mere delineation of the facts of a scene is *not* the sole or highest object of Landscape Art. If it were, there could be no comparison between painter and poet; for the most detailed and accurate description in verse of the component parts of the landscape would never convey the same notion of it to two different readers; nor can the most elaborately studied painting give us one-

hundredth part of the endless and minute detail of Nature. What we should rightly demand of the painter is less, and yet far more, than this. It is, that he should give us an insight into that which is beyond the mere detail; that he should evince a perception of the relation between the sensuous and the intellectual; that he should convey to us a sense of the feeling and harmony of the whole scene, and of that inner voice of Nature which seems to answer to every mood of every mind; that we should be conscious, in looking at his work, of that glow, caught from the artist's own imaginative spirit, which alone can breathe into it a living soul. And here it is that poet and painter are on the same ground. The former loses indeed much in definiteness of expression, as compared with the latter, but on the other hand he gains much in concentration; he can fuse the whole feeling of his imaginary scene into a word; and, having the power also to call sound to his aid, can thus make the ear become the eye to the mind. When Tennyson tells us how Elaine, sitting disconsolate in her tower,

> "mixed
> Her fancies with the sallow-rifted glooms
> Of evening, and the moaning of the wind,"

have we not the whole feeling of the melancholy fading autumn evening before us? So far as the impression on the mind is concerned, the painter could hardly give us more, though he would give it differently. It is in the modern period, however, that this poetic treatment of landscape becomes most conspicuous; but to appreciate its significance we must go back first to the morning of our literature, and notice in what light landscape appeared to our earliest, and, with one exception, our greatest poet.

The parallel has been, perhaps, a little too often drawn, in our time, between the youth of nations and the youth of

the individual; but it is impossible to read the allusions to external nature in Chaucer without being reminded of it. The delight with which he runs out among the daisies, and rejoices over the green of the early leaves in May, is exactly what we should, in the present day, describe as "childish," or rather "child-like"; that kind of artless, unchecked gladness over little things, which in our more artificial society would seem scarcely possible or suitable except in children. Not that landscape, even in this form, occupies any large place in Chaucer's writings. The early English poets in general were taken up more with men and their actions than with scenery; the stage play was everything, the decoration a trifle. We may look through all the works of Skelton, one of the most prominent of the immediate successors of Chaucer, without finding a single allusion to rural scenery, though he has much to say about country life; nor do Percy's *Reliques of English Poetry* furnish us any better in this respect. The authors of these old ballads admire little save the thews and sinews of men, and their feats in hacking and hewing; we have only an occasional reference to the "grene-woode shade" as the scene of these heroic exploits; there is little indication that the beauty of the landscape was ever present to them in any way. Turning, again, to the wider paths of the father of English poetry, we find throughout the *Canterbury Pilgrims* the interest almost exclusively human and dramatic; almost the single pointed reference to Nature being in the first six lines of the Prologue, describing the advent of Spring, and in the fresh and charming passage in the *Knighte's Tale*, rendered popular by Dryden's modernised version—

> "The merry lark, the messenger of day,
> Saluteth with his song the morning gray."

Throughout the miscellaneous poems of Chaucer, however, are scattered delightful bits of nature here and there; but even in these the manner in which the scene is touched upon, and the incidents most primarily brought forward, are as characteristic of the period as the almost entire neglect of landscape in the *Tales*. There is not an allusion to Autumn or Winter, scarcely even to the height of Summer glory; it is all Spring with Chaucer, and his sympathies with Nature seem to have blossomed anew every time the spring season came round. He was ordinarily, he tells us, a great student, nothing could take him from his books—

> "Save certainly when that the month of May
> Is comen, and that I heare the foules sing;
> And that the flowres ginnen for to spring,
> Farewell my booke and my devocioun!"

Nor does he ever bestow a glance or thought upon the solemn splendour of sunset; he is the poet of early fresh morning; he steps out cheerfully through the dewy grass, in pure exuberance of enjoyment, without a thought of its meaning. But the most striking feature in Chaucer's landscape painting is his exclusive attention to foreground and details. There is not to be found in the whole of his works an allusion to the beauty of extended landscape, of mountain or forest scenery, as we understand the words. All his thoughts are occupied by the details close to him; the green turf under his feet, the flowers and young leaves, are all that he sees. In the opening of the *Floure and the Leafe* he tells us—

> "And up I rose three hours after twelfe,
> About the springing of the day,
> And on I put my geare and mine array,
> And to a pleasant grove I gan passe,
> Long er the brighte Sunne uprisen was;

In which were okes great, streight as a line,
Under the which the grass, so fresh of hew,
Was newly sprong; and an eight foot or nine
Every tree well from his fellow grew,
With branches brode, laden with leves new,
That sprongen out ayen the Sunne-shene,
Some very red, and some a glad light grene,

Which, as methought, was right a pleasant sight;
And eke the briddes songe for to heare
Would have rejoiced any earthly wight."——

And so he proceeds till he reaches an arbour—

" whereof the grene grass
So small, so thick, so short, so fresh of hew,
That most like to grene wool wot I it was."

And again, in that exquisite little poem, *The Cuckoo and the Nightingale**—

" I went forth alone boldely,
And held the way down by a brooke side

Till I came to a laund of white and grene,
So fair one had I never in been;
The ground was grene, ypoudred with daisie,
The floures and the greves like hie,
All grene and white, was nothing elles seene.

Then sate I down among the faire flours,
And saw the birdes trip out of hir bours," etc.

In the *Assembly of Foules* he takes us into a garden, which is a perfect glitter of colour:

" A garden saw I full of blossomed bowis,
Upon a river in a grene mede,
Thereas sweetness evermore inough is,

* The authorship cf this and the last mentioned poem has been questioned; but they at all events belong to Chaucer's time and school, and in point of feeling are completely in harmony with his other works, so that the question scarcely affects the present argument.

With flowres white, blewe, yellowe and rede;
And colde welle streames, nothing dede,
That swommen full of smale fishes light,
With finnes rede and scales silver bright."

It is scarcely necessary to remark how thoroughly "præ-Raphaelite" (if one may use the expression) is Chaucer's painting, with the minute remarks on the colour of the buds and flowers, the distance of the tree stems from one another, the sparkle of the fishes' scales. There is more, however, in his moving scenes than mere still-life and embroidery, for—

"Those old Mays had thrice the life of these;"—

and we are never without the sound of the "smale foules" that "maken melodie," and "leap on the spray," as in the *Complainte of the Black Knight*, where the birds—

"So loud song that all the woode rung,
Like as it should shiver in pieces smale."

And again, we have the "cedres hie, upright as a line," and "soft as velvet the yonge grass"; the same round of buoyant child-like delight in grass and flowers, the same vivid, clear painting of foreground, never artificial or unreal, but pervaded by the wet dewy fragrance of that early outdoor life, before the pernicious compound called the "midnight oil" had been imported.

To drop from Chaucer to Spenser is, in this respect, to come from the open air into a painted chamber. The poet who sung—

"Of forests and enchantments drear,
Where more is meant than meets the ear,"

lived in a day of tropes and figures of speech, of polished metaphor and subtle allegory; and in his great poem, the

action of which (so far as it can be called action) takes place almost entirely out of doors, there is scarcely a touch of genuine landscape; his artificial groves and gardens having about as much in common with real open air scenery as their allegorical inhabitants have with real men and women. He betrays here and there a predilection (shared by other highly artificial poets) for the heavy, sombre shadows of forest scenery; and there is occasionally a sweet concord of sounds running through his scenery, the artificial character of which seems not out of keeping with the elaborate and highly wrought verse in which his Muse holds her measured pace. But in truth, Spenser's poetic genius, by nature somewhat artificial, became, in the working out of his chosen subject, so steeped in the unreal atmosphere of allegory, as to lose altogether the feeling for the landscape of real life. One example may be quoted, in which Spenser has manifestly copied Chaucer, and which, though it is not exactly landscape, illustrates very well the distinction between the two poets in their relation to nature. Chaucer's stanza occurs in the *Assembly of Foules*, immediately after the description of the garden quoted just now:

"Of instruments of stringes in accorde
Heard I so play a ravishing sweetness,
That God, that Maker is of all and Lord,
Ne heard never better, as I gesse:
Therewith a wind, * un-neth it might be less,
Made in the leaves grene a noise soft,
Accordant to the foules song on loft."

This is Spenser's amplification of the same idea:

"The joyous birds, shrouded in cheerful shade,
Their notes unto the voice attempred sweet;
Th' angelical soft trembling voices made
To th' instruments divine respondence meet;

* *i. e.*, "It could scarcely be softer."

The silver sounding instruments did meet
With the base murmur of the waters' fall;
The waters' fall, with difference discreet,
Now soft, now loud, unto the wind did call;
The gentle warbling wind low answered to all."

This is an exquisitely wrought stanza, but it is art, not nature. Chaucer would never have made the wind "warble."

And what of Spenser's great successor, whose utterances of passion and of wit have rendered the Elizabethan stage the great glory of our intellectual history? His vision at least was troubled with no mists of allegory; one of the keenest and liveliest of observers, he, in his early rambles about the Stratford district, must surely have stored up abundant recollections of the minutiæ, as well as of the wider and more extended beauties, of Nature. Yet unmistakeably as his plays indicate his acquaintance with rural sights and sounds, and with the wild flowers of his native land, little of landscape enters into his poetry; in the sonnets and lyrical pieces, where we might most expect to find it, there is less even than in the dramas. In that stirring age of chivalrous philosophers and poetical buccaneers, the actions of men were still, to poet and audience, of paramount interest; the landscape being just touched sufficiently to give the necessary localisation to the figures, but without any of that minute painting of foreground detail in which Chaucer excelled. While, however, even in what may be termed the "open air" plays, the references to landscape are scarcely more than mere passing hints, we find these given in such a way as to show that Shakespere had the whole scenery clearly before his own eye. In the *Tempest*, for instance, the indications of the scenery of Prospero's island are so genuine and vivid, that we almost seem to know the place—the barren moor, "where there is neither bush nor shrub to bear off any weather at all;" the "odd angle of the isle,"

where the disconsolate Ferdinand sits musing; the "short-grassed green" before Prospero's cell, and the "filthy mantled pool" beyond; we surely know them all, and could show "where the quick freshes are." But it is by those references to landscape which occur as illustration and poetic ornament that we chiefly become aware of the superiority of Shakespere to his predecessors. Here we first meet with the true imaginative use of poetry in transmitting to us the feeling which would be caused by the scene or the phenomenon itself, through that happy and magic use of language which in a few words fuses together the total effect of all the details of the scenery, and floats it before us on the wings of measured verse. Such is that incidental image, giving such largeness and breadth to the idea which it illustrates, introduced in *Romeo and Juliet*, (Act II. sc. 5):

> "Love's heralds should be thoughts
> Which ten times faster glide than the sun's beams,
> Driving back shadows over lowering hills."

How we look across the landscape here, and see the broad shadows successively darken the hill sides, swiftly and silently; for it is of course to the cloud-shadows that the passage refers, though by a poetical metaphor the motion which properly belongs to the clouds is transferred to the sun's* rays. Still finer is the noble simile in the same play (Act III. sc. 2), in which Romeo announces the approach of morning:

> "Night's candles are burnt out, and jocund day
> Stands tiptoe on the misty mountain top"—

* Milton has in like manner very finely transferred the motion of the clouds to the moon, in the well-known passage in *Il Penseroso*—

> "To behold the wandering moon
> Riding near her highest noon,
> * * *
> And oft, as if her head she bowed,
> Stooping through a fleecy cloud

a passage that seems to sum up in one image all the freshness and strength of morning, "a giant about to run his course." It is worth notice that nearly all Shakespere's landscape illustrations, again, are drawn from morning, and that not a single sunset occurs in his works any more than in Chaucer's. In the earlier poems and sonnets, the day dawns with something of the old artificial colouring and imagery of Spenser; the best specimen is from the 33rd Sonnet:

> "Full many a glorious morning have I seen
> Flatter the mountain tops with sovran eye,
> Kissing with golden face the meadows green,
> Gilding pale streams with heavenly alchemy."

In such a passage we trace the effect of the artificial taste of the period, not yet shaken off by him who was yet the least artificial of poets. But in the shorter and slighter references to morning in the plays, Shakespere has come out from the laboratory into the open air; we have no such gauds as "gilding" and "alchemy"; and nothing could be more truthful and beautiful than the image in *Hamlet*:

> "But look, the morn, in russet mantle clad,
> Walks o'er the dew of yon high eastern hill."

To him who has been recently characterised as the—

> "God-gifted organ-voice of England,"

landscape was, in his earlier poems, a never-failing source of illustration and adornment, before he had fallen on evil days, had become involved in the asperities of political controversy, and had lost besides the outward signs of the presence of the "Universal Pan." He, too, in his earlier poems, is singularly happy in his references to morning; the lines from *Lycidas* may be cited:

"ere the high lawns appeared
Under the opening eyelids of the morn,"

and—

"While the still morn went out with sandals grey:"

and while he sometimes shows something of Chaucer's attention to detail (the detail of middle distance, however, not of foreground), as in the well-known passage in *L' Allegro*—

"Russet lawns and fallows grey,
Where the nibbling flocks do stray,
Meadows trim with daisies pied,
Shallow brooks and rivers wide"—

he has also some of the breadth and largeness of expression which we notice in Shakspere's touches of landscape. But Milton has not in general the genuine open-air feeling of Shakspere, who seems always to write with the actual scene before him. There is apparent about his landscape a certain artificial character, a carefulness in choice of epithets, which imparts a degree of unreality to the scene. An exception, perhaps, is the simile of the storm in *Paradise Lost* (Book II. v. 488), which is in his finest and broadest manner:

"As when from mountain tops the dusky clouds
Ascending, while the north wind sleeps, o'erspread
Heaven's cheerful face; the lowering element
Scowls o'er the darkened landscape snow or shower;
If chance the radiant sun with farewell sweet
Extend his evening beam, the fields revive,
The birds their notes renew, and bleating herds
Attest their joy, that hill and valley ring."

The latter part of this passage recalls that beautiful effect in Beethoven's *Pastoral Symphony*, where the "storm" dies away, and the melody of the "shepherd's song of thankful-

ness" brings us back to sunshine and cheerfulness. But the landscape of Milton's *Eden*, stately and beautiful as it is, is for the most part highly elaborate and artificial, a character still more apparent in perhaps the most finished picture Milton has given us, the description in *Comus* of the "happy climes" to which the attendant spirit departs, which, it will be observed, he represents as combining the beauty both of spring and summer:*

> "Along the crisped shades and bowers
> Revels the spruce and jocund spring;
> The Graces and the rosy-bosomed Hours
> Thither all their bounties bring;
> There eternal Summer dwells,
> And west winds, with musky wing,
> About the cedared alleys fling,
> Nard and cassia's balmy smells.
> Iris there with humid bow,
> Waters the odorous banks, that blow
> Flowers of more varied hue
> Than her purfled scarf can shew."

This is truly a "land of Beulah," a garden-scene of some spiritualised Watteau, where the cedared alleys, blown over by scented breezes, stand dark, rich, and heavy before us. Yet the very fact of Milton's peculiar fulness and richness of colouring in these artificial scenes seems an indication that the every-day beauties of earth were of less account to him than the imaginary climes which his spirit traversed, creating ideal scenery the effect of which upon the mind is more like that produced by the paintings of Martin, or some of the latest works of Turner, than by the aspect of Nature in her reality.

If the opinion expressed at the commencement of these

* Compare Thomson, in the *Castle of Indolence*:

> "It was a season betwixt June and May,
> Half prankt with spring, with summer half imbrowned."

remarks, as to the futility of mere verbal descriptions of scenes in verse, be correct, it will serve no purpose to linger amid those trim, well-ordered parterres, through which, in decorous and symmetrical meanderings, wind the streams from the Helicon of Pope and Parnell, Collins, Warton, and Gray, and a host of lesser names, "Arcades *omnes* et cantare pares," at least as far as "swains and nymphs," "purling rills" and "whispering breezes" are concerned. The poets of this polished dead-level period could catalogue the component parts of a scene under fitting and elegant epithets; but the magic of light and shadow over an extended landscape, blown over by breezes and lit by passing showers, stirred them no more than a well painted drop-scene at a theatre. Even in such a poem as *Windsor Forest,* where the nature of the subject would lead us to expect the writer's best efforts at landscape painting, Pope describes the scene like some rhyming auctioneer showing off an estate:

> "Here waving groves a checquered scene display,
> And half admit and half exclude the day;
> So some coy nymph her lover's warm address
> Nor quite indulges, nor can quite repress;"

(a simile which has no relation on earth to the subject);

> "There interspersed in lawns and opening glades
> Tall trees arise, that shun each others shades;
> Here in full light the russet plains extend,
> There, wrapped in clouds, the *bluish* hills extend;"

but enough; our tour of inspection must terminate abruptly, in the face of so formidable a barrier as these "bluish hills." The lesser bards of the day, Parnell & Co., follow pretty universally in the steps of their chieftain; it was what might be expected in a day when poets wrote in their closet descriptions of scenery which they never cared to look at in its reality; the feeling in regard to landscape being pretty well

illustrated in the story of a nobleman of the period, who, having been decoyed into the country by a friend, and being asked if the scent of the hayfields was not delightful, replied that he liked the smell of a flambeau at the door of the theatre much better. Among the generation of poets who succeeded, of whom Thomson, Gray, and Collins alone can be said to survive, we find more warmth of colouring in landscape; in Collins's *Ode to Evening* is a picture worth quoting:

> "be mine the hut
> That, from the mountain's side,
> Views wilds and swelling floods,
> And hamlets brown, and dim-discovered spires:
> And hears their simple bell, and marks o'er all
> Thy dewy fingers draw
> The gradual dusky veil."

But excepting this, and the well known opening verses of Gray's *Elegy*, there is in all the landscape painting of these two poets an artificial polish, and a use of what may be called stock epithets of poetic diction, which makes it evident that their feeling for landscape was after all of a very *dilettante* character. The author of the *Seasons* claims more special notice. His diction is often dreadfully mannered, his descriptions lengthy and prosaic, and his Amandas and Musidoras and Lavinias, and their "young men," are sadly insipid company; but he was the first of our poets, after the reign of the Pope coterie, to return to something like genuine feeling for natural scenery, and to derive his inspirations and descriptions direct from nature, instead of cooking them to suit his own fancy. There is real beauty and freshness in this description of the close of a summer's day:

> "sober evening takes
> Her wonted station in the middle air,
> A thousand shadows at her beck. First this

She sends on earth ; then that, of deeper dye,
Steals soft behind ; and then a deeper still,
In circle following circle, gather round
To close the face of things. A fresher gale
Begins to wave the wood, and stir the stream,
Sweeping with shadowy gust the fields of corn,
While the quail clamours for his running mate."
(*Summer*, v. 1648).

This is the writing of a man of feeling and observation, who has looked at nature with his own eyes. There is an idea of wide extent, too, conveyed in this description of the prospect from a hill top, though it is more prosaic in language :

"The bursting prospect spreads immense around,
And snatched o'er hill and dale, and wood and lawn,
And verdant fields, and darkening heath between,
And villages embosomed soft in trees,
And spiry towns by surging columns marked
Of household smoke, the eye excursive roams."

I quote this partly to remark how curiously it resembles in general effect the landscapes of the elder Linnell (somewhat of a mannerist, also, in his way), who gives us the same contrast of meadow and heath, the same transition from the foreground over successive grades of distance, in many of his pictures ; even the marking of the position of the distant towns by the smoke, is a favourite incident in his middle distances. One other quotation we may take from Thomson, because it is the one instance, so far as I know, among the poets of this school, of the attempt to convey in a word the whole feeling of a scene, without going into details. The lines are in the *Ode to Solitude* :

"But chief, when evening scenes decay,
And the faint landscape swims away.

Thine is that doubtful soft decline,
And that best hour of musing thine."

The use of the expression, "swims away," to convey the idea of the gradually increasing indistinctness and fading of outline as twilight deepens into darkness, is a masterly touch; it is a whole metaphor concentrated into a single word. This is the true poetic use of language.*

After an interval of poetic stagnation, the appearance of the "Ariosto of the north," who, as Byron expresses it—

"Sung ladye-love and war, romance and knightly worth,"

seems like a protest in precisely the reverse direction from that of Thomson. The mainspring of interest in Scott's poems lies in the outburst of vigorous human life and enterprise which runs through them. Like the old bards whose spirit he had caught, he delights in the keen excitement of a chase or a combat, and has no leisure for metaphysical or poetical reflections on the landscape around, which, as in Chaucer and Shakespere, is for the most part only touched in just so far as to form a background for the figures; and

* It is suggested that Cowper's name ought not to be omitted here, as a poetic landscape painter; and his "winter morning walk," and "winter walk at noon," undoubtedly give evidence of a great love for and sympathy with the scenery around him, and a happiness occasionally in the notice and description of characteristic details of winter scenery, as in the passage, describing the redbreast flitting from spray to spray:

"where'er he rests he shakes
From many a twig the pendant drops of ice,
That twinkle in the withered leaves below."

The bareness of the winter woods is well conveyed, too, in the mention of—

"These naked shoots,
Barren as lances, among which the wind
Makes wintry music, sighing as it goes."

But Cowper is mostly very realistic, seldom rising to poetic description; and he seems to have been almost utterly without the metaphysical sense in regard to nature, and the poetry of nature. His view was obscured in this respect, probably, by the darkening influence of the religious tenets which he succumbed to, rather than adopted.

where (as in some well known passages in the *Lady of the Lake*) he does go into any lengthened description of scenery, he falls into that artificial use of epithets and similes which gives the passage the effect of theatrical scene-painting rather than of nature. On the other hand, in those slight incidental references to the landscape which give such life and reality to a story or a drama, Scott reminds us strongly of Shakespere; his hints at the scenery, however incidental, are so natural and vivid as to show that he had it clearly before his mind's eye. The first four lines of the *Lady of the Lake* give us quite a picture, though so little is definitely indicated; and what a stretch of country is indicated to us in a single couplet later on, when the chase had swept out of hearing:

> "And silence settled, deep and still,
> On the lone wood and mighty hill."

Other such passages, in *Marmion* and elsewhere, will be readily recalled; but in the main the sympathy of Scott is with the actors rather than the scenery; he does not, if I may use the expression, seem to hear the inner harmonies of Nature. It was not till, in 1812, the first cantos of *Childe Harold* broke upon the world, that the keynote was fairly struck of that hymn to the spirit of Nature, which has been sounded ever since by one poet after another, in varying and deepening harmonies. The first half of the poem dealt, indeed, mainly with human interests and memories; yet through all these there runs a panorama of landscape background, interwoven with the progress of the poem, and already characterised by a marked freedom from that fatal superabundance of detail, and those mannerisms of metaphor, which we find in all the poets for some generations previous; while occasionally we come upon passages of marvellous power and concentration of effect.

"The sun had sunk behind vast Tomerit,
And Laos wide and fierce came roaring by:"

there is the whole scene before us at once; details would only weaken the wild gloom of the picture; and throughout the poem we are conscious, in the references to landscape, of that subtle power whereby the sound, even the very aspect, of a line, is made to incorporate in a magical manner the feeling of the scene; as when we wander with the poet—

"By the blue rushing of the arrowy Rhone,"

or where the spirit of the ancient Parnassus—

"Sighs in the breeze, keeps silence in the cave,
Or glides with glassy foot o'er yon melodious wave;"

or by some river where—

"Woods along the banks are waving high,
Whose shadows in the glassy waters dance,
Or with the moonbeam sleep in midnight's solemn trance;"

while there is no more finished and delicate scene painting in English poetry than in the well-known description of an Italian sunset, or the exquisite verse on the ancient temple by the Clitumnus (Canto IV. 67):

"And on thy happy shore a Temple still,
Of small and delicate proportion, keeps
Upon a mild declivity of hill
Its memory of thee; beneath it sweeps
Thy current's calmness; oft from out it leaps
The finny darter with the glittering scales,
Who dwells and revels in thy glassy deeps;
While, chance, some scattered water lily sails
Down where the shallower wave still tells its bubbling tales."

It is, however, only in the later portions of the poem that

we are made fully conscious of the change that is coming over the spirit of descriptive poetry. Here not only do we find that the human and individual interests have almost entirely faded into the background, but we are aware of a wider and more generalising spirit in the poet's dealing with external nature, with which he almost identifies his own being:

> "Are not the mountains, waves, and skies a part
> Of me and of my soul, as I of them?"

And we come upon the first opening into that region of poetic thought and imagery which was to arise from the metaphysical contemplation of natural beauty as referable to one great Fountain of Life, where—

> "All is concenter'd in a life intense,
> Where not a beam, nor air, nor leaf is lost,
> But hath a part of being, and a sense
> Of that which is of all Creator and defence."
> (Canto III. 89.)

Of this fusing of a whole scene into the type and expression of one answering phase of feeling, we have an instance in the beautiful stanzas in the same Canto, referring to the scene of Rousseau's *Héloïse*, commencing—

> "Clarens! sweet Clarens! birthplace of deep Love.
> Thine air is the young breath of passionate thought;
> Thy trees take root in Love; the snows above
> The very glaciers have his colours caught."

And thus the poet proceeds to draw to his own thought all the sights and sounds of the landscape:

> "Mingling, and made by Love, unto one mighty end."

But whilst Byron was thus startling his readers by—

> "Things unattempted yet in prose or rhyme,"

a quiet plain-spoken man, living in a small cottage in the north of England, had also felt his way to the expression in verse of a metaphysical meaning and beauty in landscape, of a subtle sympathy between the soul of man and the spirit of nature, even more deepseated than the passionate feeling which in the full-blooded Anglo-Oriental poet was the result rather of impulse than of purpose. Not indeed that Wordsworth's passion for nature was less strong and genuine than that of Byron; have we it not given under his own hand?

> "The sounding cataract
> Haunted me like a passion; the tall rock,
> The mountain and the deep and gloomy wood,
> Their colours and their forms were then to me
> An appetite, a feeling, and a love,
> That had no need of a remoter charm
> By thought supplied, or any interest
> Unborrowed from the eye."

This youthful delight in the pure external aspect of nature, however, was soon to be involved in the "remoter charm" derived from that spirit of Pantheism, as in a qualified sense it may be termed, in which the mind of Wordsworth became steeped: the spirit which recognises, even in the ordinary incidents of Nature, hints and types of a Divinity behind the veil, pledges that all exists by one great law; that the universe is not thrown together piecemeal, as it were, by an arbitrary will, but "is as a city that is at unity with itself." And this awakens in him —

> "A sense sublime
> Of something far more deeply interfused,
> Whose dwelling is the light of setting suns,
> And the round ocean and the living air,
> And the blue sky, and in the mind of man;
> A motion and a spirit that impels
> All thinking things, all objects of all thought,

And rolls through all things. Therefore am I still
A lover of the meadows, and the woods
And mountains."

And "therefore" also, we may add, does it come to pass that human individuality becomes with Wordsworth but a part of the great pageantry of Nature, and that even the smaller incidents of colour and bloom in the landscape are, in his broad monochrome style, merged and lost in the total effect, in all but his earliest works. We find in him none of the sparkling foreground detail of Chaucer, nor the glowing colour of Byron; but he has an eye for all the grander phases of Nature, though he scarcely ever refers to them except to make them the basis of a moral or philosophical reflection, his admiration for landscape being interwoven with his moral feelings in a remarkable manner, scarcely to be found in any other poet. One passage from the *Excursion*, however, may be quoted here as a splendid example of poetic description, and as illustrating the poet's intimate and loving study of the mountain landscape amid which he dwelt. One of the party, in a secluded dell, glances upwards at two huge peaks—

"Which from some other vale peered into this.
'Those lusty Twins,' exclaimed our host, 'if here
It were your lot to dwell, would soon become
Your prized Companions. Many are the notes
Which, in his tuneful course, the wind draws forth
From rocks, woods, caverns, heaths and dashing shores;
And well those lofty Brethren bear their part
In the wild concert—chiefly when the storm
Rides high; then all the upper air they fill
With roaring sound, that ceases not to flow,
Like smoke, along the level of the blast,
In mighty current; theirs, too, is the song
Of stream and headlong flood that seldom fails;
And, in the grim and breathless hour of noon,

Methinks that I have heard them echo back
The thunder's greeting:—nor have Nature's laws
Left them ungifted with a power to yield
Music of finer tone; a harmony,
So do I call it, though it be the hand
Of silence, though there be no voice;—the clouds,
The mist, the shadows, light of golden suns,
Motions of moonlight, all come thither—touch,
And have an answer—thither come, and shape
A language not unwelcome to sick hearts
And idle spirits:—there the sun himself,
At the calm close of summer's longest day,
Rests his substantial Orb;—between those heights,
And on the top of either pinnacle,
More keenly than elsewhere in night's blue vault,
Sparkle the Stars, as of their station proud.
Thoughts are not busier in the mind of man
Than the mute Agents stirring there:—alone
Here do I sit and watch—.'"

Wordsworth appears to have a special sympathy with the sound of torrents and waterfalls—they seem indeed to belong to him, as the sea does to Homer and the stars to Goethe. Perhaps the finest instance of this is in the opening of the short poem on the death of Fox:—

"Loud is the Vale! the Voice is up
With which she speaks when storms are gone;
A mighty Unison of streams,
Of all her Voices, one.

Loud is the Vale! this inland Depth
In peace is roaring like the Sea;
Yon Star upon the mountain top
Is listening quietly."

There is not in all modern English poetry a more grand and solemn harmony than that which runs through these lines, nor could any indication of landscape be more completely in

keeping with the whole feeling of the poem with which it is connected.

Shelley's landscape is to that of Wordsworth as the mirage is to the tangible and accessible beauty of natural scenery. His universe is a mystical and shadowy region, beautiful to the mental vision, yet which we feel may fade from and elude us as we gaze on it. Coming into this land we may say, in the poet's own words—

> "Then I heard strange tongues. and saw strange flowers,
> And the stars methought grew unlike ours."

The uncertain light of a dream hangs over that scene among the Eugánean hills:—

> "In a dell, mid lawny hills,
> Which the wild sea murmur fills,
> And soft sunshine, and the sound
> Of old forests echoing round;
> And the light and smell divine
> Of all flowers that breathe and shine."

And not only the general landscape, but all the incidents of foreground, too, are touched with that vivid radiance which seems to tremble on the page, as when we read (in the *Sensitive plant*) of that strange garden, where on a stream—

> "Broad water lilies lay tremulously
> And starry river-buds glimmered by,
> And round them the soft stream did glide and glance
> With a motion of sweet sound and radiance."

Yet widely as such painting differs from the sober grey tones and realistic effects of Wordsworth, in the general view of landscape, there is in both poets the same tendency to identify it with their own feeling, and with a Universal Spiritual Presence. But the Pantheism of Shelley is characterised by an intense sympathy with the glow and pulsation of Life in

all its developments; it is the pantheism of Wordsworth startled from its dignified calm, and quickened into action and movement, as in that impassioned invocation to the Spirit of Nature in *Prometheus*, commencing—

"Life of Life! thy lips enkindle
With their love the breath between them."

There are instances also in Shelley of a remarkable power, never found but in poets of a high order, of giving the impression of some particular phase of nature, with an intensity of feeling which, as Charles Lamb expressed it, "seems to resolve itself into the element which it contemplates." The most remarkable instance of this power in our language is in that wonderful sea-dirge in the *Tempest*, "Full fathom five thy father lies," which almost seems to give up to us the secret of the sea; but in this short poem, which might be called a "frost song," Shelley is little behind Shakespere in intensity:—

"A widow bird sat mourning for her Love
Upon a wintry bough,
The frozen wind crept on above,
The freezing stream below.
There was no leaf upon the forest bare,
No flower upon the ground,
And little motion in the air
Except the mill wheel's sound."

The very spirit of cold seems to go through this; a desolation of all things. A similar example is the tropical night, in the beautiful little poem called *Lines to an Indian air.*

"The wandering airs they faint
On the dark, the silent stream,
The champak odours fail
Like sweet thoughts in a dream."

The mere fact that it is an "Indian" air seems to carry away Shelley's spirit at once into the tropical night, with its heat, and silence, and heavy scent-laden air stirring languidly over the dark stream. In such subjects, Shelley's poems resemble the designs of that strange and as yet little known genius William Blake, who had the same power, even in the slightest sketches, of giving the very essence of his subject, abstracted from all accidental incidents.

From such mystical regions, however, a recoil is inevitable; we cannot long breathe on these aerial heights; we are not unwilling to listen to the invitation of our poet Laureate to descend again to the valley, where, as he tells us—

> "Every sound is sweet;
> Myriads of rivulets hurrying through the lawn;
> The moan of doves in immemorial elms,
> And murmuring of innumerable bees."

Not but that there is much in Tennyson's view of landscape that has affinity with that of Wordsworth and Shelley; but he is more concrete than the former, and more realistic than the latter. We have the sense of the relation between human feeling and the outward aspects of nature frequently before us; but it is the harmony of special phases of natural scenery with special moods of an individual mind, rather than the wider but somewhat vague and colourless pantheism of Wordsworth. We have something of the glow and sparkle of colour which characterises Shelley; but it is not derived, like Shelley's, from imaginary climes, but from the living landscape around us, and especially from that of our own country; so that Tennyson may be said to be, in a special manner, and more than any other poet, the painter of *English* landscape. He has the power, indeed, of throwing himself into the spirit of other climes, as in the concluding verse of

the little poem suggested by reading a book of travels in Greece, which he describes as a land—

"Where many a slope was rich in bloom,

From him who on the mountain lea
  By dancing rivulets fed his flocks,
  To him who sat upon the rocks
And fluted to the morning sea;"

a verse which comes to us like a breath from the old Greek world of clear air and blithe feeling: and how he can paint a tropical scene we know since *Enoch Arden* was written. But in glancing through such charming Idylls as the *Gardener's Daughter* or the *Talking Oak*, or turning the pages of *In Memoriam*, we must be struck by the vividness with which a hundred familiar incidents of English landscape are pourtrayed. There is such an *embarras des richesses* here, in fact, that one scarcely knows where to choose; but we may contrast one or two of the numerous beautiful sketches in *In Memoriam*. A description of the return of Spring, an April day—

Now rings the woodland loud and long,
  The distance takes a lovelier hue,
  And, drowned in yonder living blue,
The lark becomes a sightless song.

Now dance the lights on lawn and lea,
  The flocks are whiter down the vale,
  And milkier every milky sail
On winding stream or distant sea.

Contrast with this the description of an October morning:—

Calm is the morn, without a sound,
  Calm as to suit a calmer grief,
  And only though the faded leaf,
The chestnut pattering to the ground.

Calm and deep peace on this high wold,
  And on these dews that drench the furze,
  And all the silvery gossamers
That twinkle into green and gold.

Calm and still light on yon great plain,
  That sweeps, with all its autumn bowers,
  And crowded farms, and lessening towers,
To mingle with the bounding main.

This last verse may recall the passage quoted from Thomson, descriptive of a prospect from a hill; but how far more concentrated and powerful is Tennyson's picture. Equally fine is the description of a stormy sunset in another section of the poem:—

"To-night the winds began to rise,
  And roar from yonder dropping day,
  The last red leaf is whirled away,
The rooks are blown about the skies.

The forest cracked, the water curled,
  The cattle huddled on the lea,
  And wildly dashed on tower and tree
The sunbeam strikes along the world."

The last two lines are remarkable for energy and wildness of effect. The truthfulness of sound in Tennyson's descriptions is also remarkable; as in the short description of the thunderstorm in *Vivien,* where the "stammering cracks and claps" of the thunder as it bursts over head, and the subsequent withdrawal of the storm into the distance —

"Moaning and calling out of other lands"—

are given in a way which makes "the sound an echo to sense" to a degree rarely achieved in poetry. The peculiar beauty of Tennyson's descriptions of morning may be noted; they are always touched with a loving hand; the conclusion of No. XCIV. in *In Memoriam* is an exquisite instance, rather

too long for quotation here; but we may notice the description at the close of the poem called *Love and Duty*, so full of the bright light of morning: –

> "Then when the first low matin chirp hath grown
> Full quire, and morning driven her plough of pearl,
> Far furrowing into light the mounded rack,
> Beyond the fair green field and eastern sea."

One other observation should be made in regard to Tennyson's treatment of landscape; that a great deal of its poetical completeness of effect arises from the fact that he does not fail to connect all the details of growth and colour and bloom with the great system of cosmical life and reproduction, of which they are only separate manifestations; you generally feel that in his descriptions he is looking beyond the details, and is fully alive to the physical unity of Nature; thus fulfilling what Humboldt describes as a condition of really poetic description of landscape, viz., "the perception of the universality and reciprocal limitation and unity of all the vital forces of nature." Perhaps the finest instance of this is in a splendid passage in *Maud*, which must form our last example: —

> "A million emeralds break from the ruby-budded lime"—

this is a touch of detail which reminds us of Chaucer's descriptions of spring; but this one incident of returning life at once carries off the imagination of the modern poet round the whole blooming and blossoming hemisphere:—

> "A million emeralds break from the ruby-budded lime,
> In the little grove where I sit; ah! wherefore cannot I be
> Like things of the season gay, like the beautiful season bland;
> Where the far-off sail is blown by the breeze of a softer clime,
> Half lost in the liquid azure bloom of a crescent of sea,
> The silent sapphire-spangled marriage-ring of the land."

And now, if we turn our thoughts back again for a moment to the pages of our earliest poet, what an extraordinary contrast do we see between the space occupied by landscape in his works, and the feeling with which it is regarded, as contrasted with that of the most popular poet of our own day. In the tales of Chaucer, even the bare hints of the landscape given here and there, as well as the more detailed descriptions in isolated poems, are confined to bits of foreground detail, against which the figures are relieved in hard clear outline. In the poems of Tennyson, the space occupied by landscape is enormous in proportion. In his earlier poems it pervades everything. In his *In Memoriam* a very large part of the book is taken up by pictures and reflections on landscape, which he connects in one way or another with the object of the work; nay, he even identifies his lost friend with nature:—

> "Thy voice is on the rolling air,
> I hear thee where the waters run,
> Thou standest in the rising sun,
> And in the setting thou art fair."

And if we compare the *Idylls of the King* with the old romance on which they are based, we find that, while in the latter the figures are everything, and the landscape scarcely noticeable, in the modern poet's version the figures are, in many cases, almost lost in the landscape, as in Gustave Doré's designs, whom Tennyson in this respect rather resembles. And we find withal a meaning, a beauty, a feeling attributed to the landscape scenery, of which the earlier poets do not show the faintest trace. To Chaucer, the buds and the flowers are playthings; to Wordsworth, they are types and similes of moral beauty; to Tennyson, they are a part of a vast system of Life, endless, beautiful and incomprehensible. How are we to account for this

wonderful difference in the view of the same things, the same permanent scenes (if they really are so), by persons possessed of the same organs and senses? Must we not inevitably connect such a change with the conviction (now gaining wider and wider acceptance) of the progressive development of human intellect, of the existence of "possibilities of sensation" (to use Mill's phrase) which did not exist four hundred years ago? It is true that the progress from the realistic to the ideal view of landscape is not uniform. There are intervals of reaction in favour of predominant or exclusive human interest in poetry, such as we see in Pope and in Scott, and in the present day in Browning, whose works may be taken as the modern protest in favour of humanism. But on each occasion, when the poetic mind of the nation, after the first excitement of a new period of human activity, reverts to the surrounding scenery, we find that new vistas have been opened, that the eye ranges over a wider prospect, that the soul drinks a delight therefrom, of which former generations seem to have had no conception. I do not say, of course, that Tennyson is a greater poet than his predecessors; on the contrary, the disproportionate predominance of landscape in his works I should consider an artistic defect; but he is a greater *landscape* poet, and the immense popularity of his works makes it evident that in this interest in landscape he expresses the feeling of his own day. And this progressive advance in the interest in landscape is not out of keeping with the most recent views on the development of the human race. I have heard it suggested, in reference to the extent of observation in animals, that these see only what immediately concerns them, and are practically blind to distant objects in the landscape. May not something like this be true of man in his barbarous or semi-barbarous state? In times of mere physical existence, when men were engaged in a real "struggle for life," when they had no

means of generalising up to the idea of a Universal Law in Nature, but were occupied in fighting against physical forces but partially understood, and in providing for the claims of hunger, what room could there be for perception of the beauty of the landscape? The streams were mere fishing places, the hills impediments in their hunting excursions. And in the earlier stages of civilised life, as we have seen, the interest in nature is but that childish delight which leaps at the sound of the brook, and laughs with the opening buds and flowers, but sees and hears no further than these. It is only when travel and national intercourse have extended the means of observation, when science has done something towards grouping the hitherto isolated phenomena of Nature, and indicating their harmony and connection, that the foundation is laid for that wider view which connects man in his own eyes with the world around him, by whose laws he must live, and extends his sympathies continually in wider and wider circles from the centre of his self-consciousness. In this view, we may call science the true parent of landscape painting; at least, we are already conscious that through one especially modern science, geology, we have had opened to us a wider range of interest in landscape, not, as heretofore, in regard to space, but in regard to time. This has already made itself felt in our poetry. What is the meaning of such a verse as this, for instance, in *In Memoriam?*

> "There rolls the deep where grew the sea:
> O Earth, what changes hast thou seen!
> There, where the long street roars, hath been
> The stillness of the central sea."

Such a reflection would have been possible to no poet before the present century, scarcely before the present generation; for it is not till scientific ideas are a part of the popular faith that they find place in poetry. But to us, and to the poet of

our day, the landscape around us is no longer a thing of yesterday, a mere decoration of our lives, a collection of lovely embroidery and spangles to please the curious eye; but a vast panorama of life and beauty, governed by unchangeable and universal laws, and connected with our own life by a chain of physical causation, which seems to bring our ideas and our being into relation with far-distant epochs of planetary life. This latter thought is evidently present in the concluding verse of the following passage from one who, if not a great poet, is at least one of the most highly cultured and sensitive intellects of our day :—

Blow, ye winds ! lift me with you,
  I come to the wild :
Fold closely, O Nature,
  Thine arms round Thy child.

To thee only God granted
  A heart ever new,
To all always open,
  To all always true.

Ah ! calm me, restore me,
  And dry up my tears
On thy high mountain platforms,
  Where Morn first appears.

Where the white mists for ever
  Are spread and unfurled,
Mid the stir of the forces
  *Whence issued the world.**

* Matthew Arnold : *Switzerland.*

THE STRATA BELOW THE TRIAS IN THE COUNTRY AROUND LIVERPOOL; AND THE PROBABILITY OF COAL OCCURRING AT A MODERATE DEPTH.

By GEORGE H. MORTON, F.G.S.,
HONORARY SECRETARY LIVERPOOL GEOLOGICAL SOCIETY.

COAL has long been supposed to underlie the New Red Sandstone of Lancashire, Cheshire, and other parts of England. In 1845, a paper was read before the Geological Society of London, "On the relation of the New Red Sandstone to the Carboniferous Strata of Lancashire and Cheshire," by E. W. Binney, F. G. S. In that paper, the strata at Sutton, Whiston, and Huyton (places east of Liverpool) were described for the first time, and the author states that there is every reason to believe that coal occurs beneath the New Red Sandstone. A more recent paper, "On the Permian Beds of the North-west of England,"* and another, entitled "Further Observations on the Permian and Triassic Strata of Lancashire,"† both by Mr. Binney, contain his latest observations on the subject. These communications were of great value to the Geologists who surveyed this part of the country for the Government Geological Survey during the years 1854–60. The maps published by the Survey are based on the Ordnance maps, which are geologically coloured, and of incalculable value to the mining industry of the country. Whether on the scale of one inch or six inches to the mile, the petrological details, as well as the general succession

* Transactions of the Literary and Philosophical Society, Manchester, Vol. XII., 1855.

† *Ibid.*, 1865.

of the geological formations, are shown with an exactness previously unknown.

There are, however, very few of the Survey maps that can be considered strictly accurate. The geological surveyors seem to consider themselves bound to complete the map they are engaged upon, although much of what appears to have been ascertained is not to be accepted as finally determined. In order to thoroughly understand the maps, a considerable knowledge of geological field-work is necessary; and this enables the geologist to discover how far they may be trusted as explanatory of the structure of the district they represent. At the Birmingham meeting of the British Association in 1865, I heard the late Professor Jukes remark, that persons must not trust implicitly to the Survey maps, or run into mining adventures relying upon their authority, without a geological surveyor to explain them. But, though some details in these valuable maps cannot be relied upon, it is very important to remember that an absolutely correct one is almost an impossibility, without such a series of expensive borings and excavations as it would be unreasonable to expect. The maps, as published, are the result of a most minute examination of the surface of the country, including every natural section, quarry, and other excavations that afford a view of the rock. Much information is also obtained from railway cuttings, and the shafts of collieries and mines, all of which tend to elucidate the geology of a district; but the country is usually so deeply covered with drift—the waste of the Glacial period—that much is of necessity left to conjecture.

I must not omit this opportunity of stating, that the whole of the maps and sections of the Geological Survey are in the Liverpool Free Public Library. This is a great advantage, for the cost is so considerable that few persons can easily purchase them.

In many cases, descriptions of the maps have been published. The "Geology of the Country around Wigan," and the "Geology of the Country around Prescot," by Edward Hull, B.A., F.G.S., are all that relate to this neighbourhood.

Perhaps it may be desirable to remind you of the order and position of the successive geological formations * that occur in the country bordering the Dee and Mersey, and represented on the Geological Survey Maps, commencing with the lowest, viz.—

PALÆOZOIC.

Silurian	Wenlock Shale.	
Devonian	Old Red Sandstone.	100 feet.
Carboniferous	Carboniferous Limestone	1,200 „
„	Millstone Grit	1,000 „
„	Lower Coal-measures	1,800 „
„	Middle or Productive Coal Measures	1,500 „
„	Upper Coal-measures	1,200 „

MESOZOIC.

Permian	Permian Sandstone	300 „
„	„ Marl	50 „
Trias	Lower Bunter	400 „
„	Pebble-beds	350 „
„	Upper Bunter	400 „
„	Keuper Sandstone	450 „
„	„ Marl	100 „
Recent	Superficial Accumulations	50 „

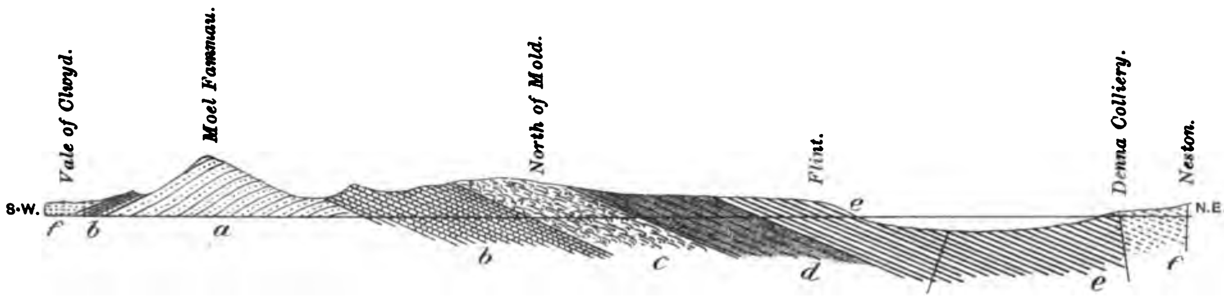
These geological formations do not always follow each other in regular order, without interruption. The base of the Old Red Sandstone or the Carboniferous Limestone when it

* Described in Proceedings of the Liverpool Geological Society, Session 7th, 186 -6.

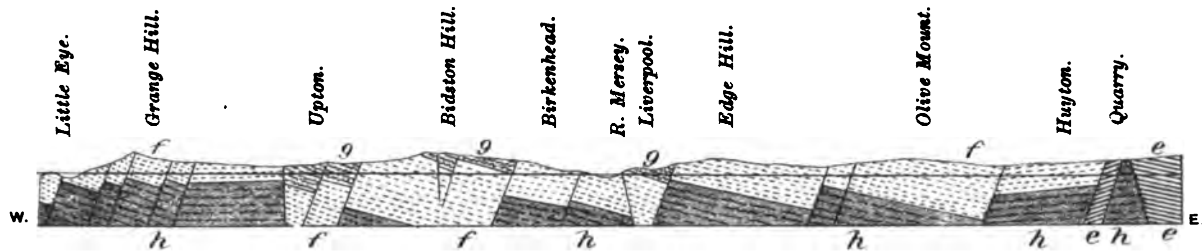
is absent, rests upon the denuded edges of the Wenlock Shale; but all the members of the Carboniferous system follow each other in regular succession. There is probably a natural break between the Coal-measures and the Permian, and again between that formation and the Trias, whose sub-divisions then occur in regular sequence.

At the close of the Carboniferous period, the whole of the country I am describing was covered by a continuous deposit of Coal-measures, with the underlying Millstone Grit and Carboniferous Limestone in an undisturbed position. Some idea of the enormous denudation that has since taken place may be obtained from the fact, that all these Carboniferous-strata, 6,700 feet in thickness, have been denuded from the Wenlock Shale of Denbighshire and Flintshire.

It is a geological truism, that lines of elevation are lines of weakness and waste, and that mountains crumble away when exposed to sub-aërial action for geological ages. Lines of depression, on the contrary, are lines of strength and durability, for the rocks are then buried and protected from denuding agencies. In this manner the Carboniferous-strata, which once covered the high land of Flintshire, and formed an anticlinal curve, have been swept away, and only scattered patches of the limestone at the base left to indicate their former position; while more to the N. E. there has been less elevation, and consequently such a reduced denudation, that a fringe of Coal-measures occurs along the S. W. of the Dee. Still further to the N. E., in Wirral, the gradually increasing depression brings in the New Red Sandstone, overlying the Coal-measures, which seem to be fully developed and undenuded below it. The Coal-measures continue in this relatively depressed condition, until thrown up by a great fault to the east of Liverpool, where the Trias and Permian have been denuded. The structure of the



No. 1.—SECTION OF STRATA FROM THE VALE OF CLWYD TO LITTLE NESTON.



No. 2—SECTION OF STRATA FROM THE RIVER DEE TO HUYTON.

a Wenlock Shale. *b* Carboniferous Limestone. *c* Millstone Grit. *d* Lower Coal-Measures
e Middle or Productive Coal-Measures. *f* Bunter Sandstone. *g* Keuper Formation. *h* Upper Coal-Measures.

country, as well as the general succession of the strata, are shown in the opposite sections, Nos. 1 and 2.

In the year 1861 I read a Paper before this Society, "On the Coal-measures in the neighbourhood of Liverpool, and the probability of their Extension beneath the Town;" and in 1864 exhibited a "Section of the Strata at Thatto Heath, near Rainhill," before the Liverpool Geological Society, and attempted to prove the certainty of workable beds of coal being under the Trias, and that they were merely cut off by the great fault which throws up the Coal-measures at that place.

Recently many circumstances have combined to direct great attention to our supply of coal. The quantity contained in the coal-fields which occupy the surface of the United Kingdom has recently been estimated by the Coal Commission, as well as the probable quantity that may possibly be obtained from under the Permian and Triassic-strata, by working to the depth of 4,000 feet, which is considered to be practicable by mining engineers and others qualified to give an opinion.

The recent rapid advance in the price of coal has created an interest in all that relates to an increase of the supply from new sources. In September last a letter appeared in the Liverpool *Daily Post*, by Mr. T. Mellard Reade, C. E., F. G. S., with the heading, "Coal under Liverpool," in which he described the conditions under which the Triassic-sandstone and the Coal-measures occur in the country immediately around Liverpool; and expressed somewhat sanguine hopes of coal being obtained from under the Trias in this district. There were some other letters, including my own, as well as editorial articles on the subject, but the occurrence of the Coal-measures beneath the Trias was not in any respect questioned.

I do not think that any geologist can doubt the existence of the Coal-measures, and consequently of coal, under the New Red Sandstone between the River Dee and Huyton; and my impression is that mining engineers and colliery proprietors are of the same opinion. Mr. Edward Nixon, a mining engineer, who read a Paper before the Liverpool Geological Society in 1866, says: "At Chester we have good opportunities of examining the New Red Sandstone, which no doubt covers a large and extensive Coal-field, extending under a great portion of Cheshire and Lancashire. I believe some of these coals to be almost within workable distance; and a time is not far distant when means will be adopted to prove them."

The Coal-measures do not, however, always underlie the New Red Sandstone, as can be proved by numerous sections in North Wales. In the Vale of Clwyd, the New Red Sandstone rests upon the Wenlock Shale over a considerable area. South of Denbigh it overlies the Old Red Sandstone, and in many localities in the same district it reposes upon the Carboniferous Limestone.

There is no chance of obtaining coal anywhere in the Vale of Clwyd, for the Carboniferous-strata were deeply denuded, and in many places washed away altogether before the Permian and Trias were deposited over the country. Between Wrexham and the Dee the Trias rests successively on the Permian, the Millstone Grit, and the Coal-measures. Under part of Wrexham the Permian is developed, covering the Coal-measures on the west, and underlying the Trias on the east.

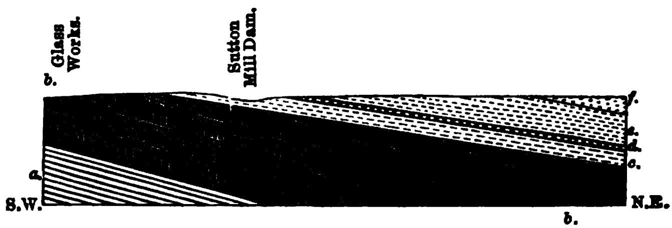
The great, or rather the enormous, denudation of the Carboniferous-strata on the S.W. of the Dee, has evidently been caused by the upheaval and consequent exposure of the country to denuding influences; while the Coal-measures to the N.E. were protected from denudation in a depression, probably beneath the sea. The average elevation of the

base of the Carboniferous Limestone, where it crops out in Flintshire, is about five hundred feet above the sea level; it then gradually deepens, and is thrown down by faults as it advances northwards. Its depth below the Red Marl area in Wirral is about nine thousand feet, which is a very rapid descent in thirteen miles. Under the Royal Institution it is nearly as deep, and it does not reach the surface again much nearer than Clitheroe, near Preston. This remarkable difference of level, in a single geological horizon, seems to have originated at the close of the Carboniferous period, and to have continued ever since; but the denudation of the mountain mass of strata, from the hills of Flintshire and Denbighshire, was completed before the deposition of the New Red Sandstone.

The faults that traverse the Triassic-strata, in Wirral and South Lancashire, seem to be of the same age as those which fracture the Coal-measures to the N.E.; and it is unlikely that the Coal-strata below the Trias are much broken by faults unknown at the surface. The faults were probably formed during the Liassic period.

But the great question is, Whether the Coal-measures beneath Wirral and South Lancashire were denuded before the New Red Sandstone was deposited over them, and, if so, to what extent? The general conclusions to be drawn from the geological character of the country tend to show that the Coal-measures were not denuded; but it would be unwise to trust such a conclusion, for it is possible that there may have been partial denudation with a subsequent subsidence, and, if so, the New Red Sandstone may in certain places rest on the Carboniferous Limestone or the Millstone Grit, instead of the Coal-measures. Such an ancient denudation is not worth serious consideration, for the general depression that has been described N.E. of the Dee, is very strongly supported by several sections to which

I have now to direct your attention, tending to prove that the Coal-measures lie fully developed below the Trias.



SECTION AT SUTTON, ST. HELENS. No. 3.

(HALF-A-MILE.)

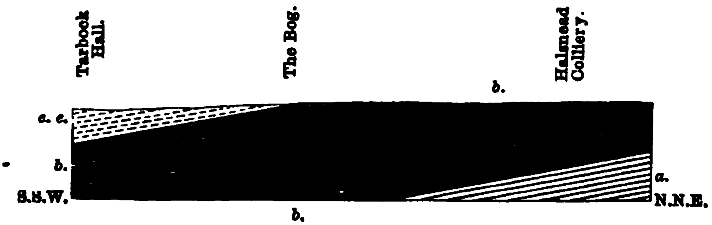
a. Middle or Productive Coal-Measures.
b. Upper Coal-Measures. *c.* Permian Sandstone.
d. Permian Marl. *e.* Lower Bunter.
f. Pebble-beds.

In this section the lowest strata visible at the surface are the Upper Coal-measures, without any seam of coal of a workable thickness. They are made up of variegated sandstones and red clays, the higher strata being exposed about Sutton mill dam. These red Coal-strata are succeeded by the Permian Sandstone, Permian Marl, Lower Bunter Sandstone and Pebble-beds in regular order. The Upper Coal-measures are probably above 1,200 feet in thickness, and dip at various angles from six to twelve degrees; but they are not exposed near the Permian, so that the unconformity of the latter is not precisely ascertained. However, the general succession of the formations shown in the section is very clear, and they all dip in the same direction at a low angle.

This section is very important, for it proves that the Upper Coal-measures were not denuded about Sutton before the Permian and Trias were deposited. It also shows the particular strata that occur between the Bunter Pebble-beds and the Productive Coal-measures in the neighbourhood of

St. Helens. The thickness of the Permian is supposed to be about 350 feet, but I do not know that it has been proved to be so thick by boring. The Permian Sandstone below the marl cannot be distinguished from the Lower Bunter Sandstone, which may hereafter prove to be Permian.

At Edge Green, near Wigan, the shaft of a colliery passes through the Trias and Permian into the Coal-measures, and reaches the "Main Delph Coal," at the depth of only 475 feet, proving considerable denudation of the Upper Coal-measures in that locality, which is five miles N. E. from Sutton.



SECTION AT HALSNEAD. No. 4.

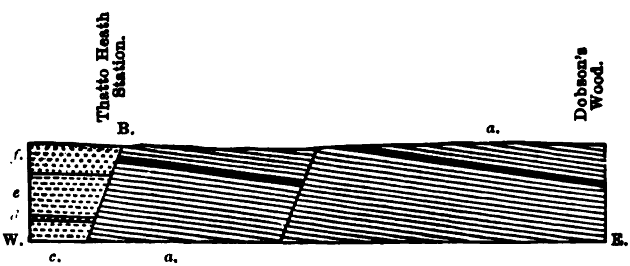
(ONE MILE.)

a. Middle or Productive Coal-Measures.
b. Upper Coal-Measures.
c. c. Permian Sandstone or Lower Bunter.

This section represents a line across the country south of Huyton Quarry, in the direction of Tarbock, and it is very similar to that at Sutton; but the succession of the strata is not so clear as at that place, for the land is everywhere covered with drift, so that the strata can seldom be seen. The Middle Coal-measures are well known by the numerous coal-seams which are worked in the district; and some of the pits pass through the lower part of the Upper Coal-measures. Some old pits, now filled up, which belonged to the Earl of Sefton, near Tarbock Hall, are said to have passed through red sandstone, but whether Permian or Trias is

uncertain. Some miners are of opinion that the New Red Sandstone is brought in by a fault, and that the coals could not be worked further S. S. W. in consequence. But although the regular succession from the Coal-measures to the Trias is uncertain, the occurrence of the Upper Coal-measures is clearly established, so that they were not denuded before the deposition of the New Red Sandstone in the country around Prescot.

The Upper Coal-measures at Halsnead seem to be 1,200 feet thick. Whether faulted or not they are succeeded by the Lower Bunter Sandstone, and there is sufficient unproved ground for the Permian to crop out between it and the Upper Coal-measures. Further to the S. S. W. the Lower Bunter is covered by the Pebble-beds.



Section at Thatto Heath. No. 5.

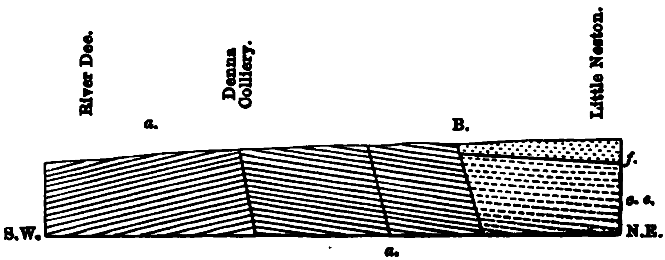
(One Mile.)

a. Middle or Productive Coal-Measures.
c. Permian Sandstone. d. Permian Marl.
e. Lower Bunter. f. Pebble-beds.

This section exhibits the Middle or Productive Coal-measures thrown up by a great fault against the Pebble-beds of the Bunter formation at Thatto Heath, which is about a mile and a half to the north of Rainhill. The Ravenshead Higher and Main Delf Coals are near the surface, and they are faulted in the centre of the section. These coal-seams

mark the horizon at which the Rev. H. H. Higgins obtained such an extraordinary collection of plants and other fossils in 1870.* The section is along the line of the railway which crosses the boundary fault B, about one hundred yards W. of the bridge at Thatto Heath Station. When the railway-cutting was excavated this fault was exposed, and a sketch of it will be found in the *Proceedings of the Liverpool Geological Society* for 1869–70, appended to a Paper on "The Sections of Strata exposed on the Huyton and St. Helens branch Railway," by C. Ricketts, M.D., F.G.S. The fault has thrown up the Coal-measures about 3,000 feet, and it would be necessary to descend that depth on the downthrow side to reach the broken-off continuation of the Ravenshead Coal-seams, which belong to the central portion of the Productive Coal-measures. Such a dislocation cannot have destroyed any of the strata, for it is a simple fracture, leaving the order of succession on both sides of the fault unchanged. The denudation of the surface about Thatto Heath has been very great. If there had been no such denudation, the strata on the E. side of the fault would have formed a step, or precipitous ridge, 3,000 feet higher than the W. side. Not only has that mountain mass been removed, but the surface has been still further planed down another 1,000 feet to its present level, and presents little external indication of the line of dislocation. Considering that at Sutton, within two miles, the Upper Coal-measures and the Permian are both fully exposed, there can be little doubt that these formations, as well as the higher coal-seams, those above the Ravenshead beds, have all been denuded, along with the Triassic strata, from off the Middle or Productive Coal-measures exhibited in the section, and that they occur beneath the Trias on the W. of the great dislocation, B.

* Proceedings Liverpool Geological Society, Session 13th, 1871–2.



SECTION AT DENNA, LITTLE NESTON. No. 6.

(HALF-A-MILE.)

a. Middle or Productive Coal-Measures.
e. e. Permian Sandstone or Lower Bunter.
f. Pebble-beds.

This section intersects the boundary fault B, between the Bunter Pebble-beds and the Middle or Productive Coal-measures at Denna, near Little Neston, Cheshire, where a colliery was worked about twenty years ago. There are four or five seams of coal which are supposed to include the equivalents of the "Brassey," "Main," and "Lower Four-foot" coals of Flintshire.* The position of these coal-seams in the Flintshire coal-field is about 300 feet from the top of the Middle Coal-measures, so that the same horizon is worked on both sides of the Dee. The Upper Coal-measures, and probably the Permian, have been denuded on the S. W. of the fault, but underlie the Trias on the N. E. The fault has thrown up the strata on the S. W. about 2,300 feet, and as the ends of the Coal-measures are thereby abruptly cut off, they are certainly continued on the other side of it, under the New Red Sandstone.

At Shotwick, about four miles S. E. from Neston, a boring has recently been made in search of coal,† where the Lower Bunter was proved to be 510 feet thick, and to rest

* *Coal Fields of Great Britain*, 3rd ed., p. 211, by Edward Hull, M.A., F.R.S.

† This information was kindly communicated to me by Mr. G. W. Shrubsole, Chairman of the Geological Section of the Chester Society of Natural Science.

upon the Coal-measures. As the boring did not commence immediately beneath the Pebble-beds, but on the low land near the Dee, the total thickness of the Lower Bunter must approach 800 feet. If the Permian Marl does not extend so far south as Neston and Shotwick, the Permian Sandstone could not be recognised, especially from the sand brought up a bore-hole; though, so far as the depth of the Coal-measures is concerned, the thickness of this lower subdivision of the New Red Sandstone at Shotwick, is about that estimated for both the Lower Bunter and Permian together.

The four sections I have described, explain the petrological conditions under which the Coal-measures occur in the country around Liverpool. They might easily have been multiplied, but the same general conclusions would inevitably be drawn. The two sections (5 and 6) where the Coal-measures are faulted against the Trias, prove the former are continued below it; and there can be no reasonable doubt that the Coal-measures extend, fully developed, under the whole of the area between the River Dee and the rise of the same strata to the east of Liverpool. The sections at Sutton and Halsnead prove the presence of the Upper Coal-measures at those places; and there are the strongest reasons for concluding that they have been denuded with the New Red Sandstone wherever the Middle or Productive Coal-measures occur at the surface. It is also equally probable that the Upper Coal-measures, and the Permian in an attenuated form, underlie the Triassic-strata between Huyton and the Dee.

It is remarkable that so little is known about the Permian in this neighbourhood, and that it is perhaps only exposed at Sutton. This is the reason why the formation has been supposed to be absent altogether more to the S.W.;

indeed Prof. Hull, F.G.S., describes the Lower Bunter as resting directly upon the Coal-measures in Croxteth Park, but I think that the red and yellow sandstones in that section may possibly be Permian.

Around Manchester the Trias has suffered greater denudation than about Liverpool. The Keuper has been denuded altogether, and the Bunter Sandstone so reduced in thickness that coal-pits pass through it to the Coal-measures in several places.* In the country around Liverpool the Trias is much thicker, and consequently the Coal-measures lie at a greater depth; and the Permian is not exposed at the surface, though the probability of its occurring beneath the Trias is very great. The depression of the Coal-measures that has been described would not only allow its deposition, but prevent its subsequent denudation. It is important to remember that the Permian occurs in the Vale of Clwyd,† where mottled sandstone and marl contain plant remains; but the country is so deeply covered with drift that the strata can seldom be seen.

Assuming that the Middle or Productive Coal-measures underlie the New Red Sandstone in the country around Liverpool, the question is whether we can reach the coal, and whether there is a fair chance of success in trying to obtain it. So far, no one has tried with sufficient capital and knowledge of the subject to have had any chance of doing so. Many attempts have certainly been made, principally in the Keuper Marl and Sandstone, 2,000 feet above the Coal-measures, by persons who thought that they were boring in coal-strata until they discovered their mistake and abandoned the undertaking. Several such borings have been made about the Red Marl area in Wirral, and there was

* Patricroft, etc.; see Binney, *Ib.*

† *Report of the British Association*, 1865, p. 67, and Ramsay's *Geology of North Wales*, p. 225.

another at Waterloo. Miners have told me that there is coal under St. James's Cemetery; and only recently I was informed that the Waterloo Tunnel passes through the Coal-measures, whereas it is in Keuper and Bunter Sandstone. In all these instances, the similarity between the yellow sandstone and grey shale of the Keuper and the Coal-measures caused the mistake.

In the event of a boring being made in search of coal below the Trias, it would be desirable to select a spot where the strata have been denuded, and where the Pebble-beds or lower sandstone of the Bunter formation occur at the surface. The Lower Bunter is considered to be 400 feet thick; but as its base is not known with certainty in any section nearer than Sutton, no great reliance can be placed on this estimated thickness. Besides, it may vary considerably if the Coal-measures present a denuded or an eroded surface. If, on the contrary, there has not been any material denudation, the thickness must be uniform, or nearly so. Assuming the Lower Bunter to be 400 feet thick, and that there is no Permian below it, the Coal-measures at Grange and Eastham, in Wirral, and under Crown Street in Liverpool, must be very near the surface, perhaps only 300 feet below it; but they would probably be the Upper Coal-measures, in which there are no workable coal-seams.

The numerous wells for the supply of water around Liverpool have bore-holes which descend to various depths down to 681 feet.* Bootle well, 600 feet deep, is the only one that can have passed through the Trias; but as the quality of the water has not changed in consequence of the depth, it is unlikely that the Coal-measures have been reached.

Although there are many spots favourably situated for an experimental boring, any person who undertakes the task

* Water Street well is 681 feet, but is in the Keuper.

must be prepared to run the risk of finding a few hundred feet of Permian-strata. He must be prepared for 1,200 feet of Upper Coal-measures — red-strata which colliery engineers never like — though they may not be so thick as supposed. If there has been little denudation of the Coal-measures before the deposition of the Permian, it seems probable that, with the base of the Bunter Pebble-beds at the surface, the Upper Coal-measures would be reached at about 800 feet, and the Middle or Productive Coal-measures at 2,000 feet; but no attempt should be made with a pecuniary object unless the projectors were able to bore a few hundred feet deeper if necessary.

Coal *might* certainly be reached at a much less depth than 2,000 feet, and probably would be; but as a set-off against that chance, there is a probability of having to go lower still, and a possible chance, remote though it be, of not finding coal at all. The mere depth, however, does not present much difficulty, for there are several coal-pits worked that far below the surface; but there was little or no risk in opening those collieries, for the existence of a particular coal-seam at a calculated depth must have been known beforehand.

In selecting a spot for boring, it is desirable to keep away from the great boundary faults, between the Coal-measures and the Trias, such as those shown on the sections (B. No. 5 and 6), for the strata on each side of such faults are often so broken up that the coal-seams cannot be worked with profit. This is the case at Huyton, where the coal-seams are thrown on end, and so contorted that a colliery opened some years ago had to be given up after a large sum of money had been lost. A shaft was sunk in the Trias at Huyton about twenty-five or thirty years ago. It was very near the boundary fault, and the water came in so rapidly that it had to be given up.

Supposing a boring to have been made, and a seam of coal discovered of sufficient thickness to work, it would then be necessary to make another bore-hole to discover the dip or inclination of the seam, in order to ascertain the direction in which the coal would have to be worked; for that would determine the purchase or lease of the mineral rights from the owners of the surface property; and it would be desirable to arrange that in every direction before the boring was commenced, so that the rights required could be easily taken up when coal was found. Most probably other borings would be necessary, before sinking a shaft in order to guard against faults, otherwise great difficulty might be experienced, and heavy expenses incurred, that might have been avoided by a better knowledge of the ground. These preliminary difficulties which the mining engineer would have to encounter, with the large capital that must be absorbed before it could be decided to sink a shaft and open the colliery, tend to prevent speculation in this hidden coal-field.

But the great difficulty is to obtain the first experimental boring, for if that were successful in reaching coal an important section of the superincumbent strata would be obtained, from which very important conclusions might be deduced. If, for instance, there were Permian and Upper Coal-measures with no apparent denudation, the thickness of these formations would be known, and it would be safe to assume that the same conditions extend under a considerable area of the country around Liverpool. Under such a regular succession of the formations, the depth of the workable coal-seams in the Prescot and Flintshire coal-fields, beneath the New Red Sandstone, might be approximately ascertained. But if on the other hand a coal-seam in the Productive Coal-measures were found directly under the Trias, although the undertaking might be a profitable speculation in itself, there

would be much doubt and uncertainty about the result of any other boring that might be made at a distance from the first, so that the general result would be far less satisfactory. For if the Coal-measures were faulted and irregularly denuded before the New Red Sandstone was deposited over them, each explorer would gain little by the experience of his predecessors, but would have to take his chance and be content with the result—coal or no coal—as might happen. However, in either of these supposed cases the thickness of the Trias would have been proved, and the presence or absence of the Permian and Upper Coal-measures determined.

In conclusion, I think that I have demonstrated that there is a valuable coal-field beneath our feet. It would be easy to prove it absolutely for about £2,000, but it is a question whether it is worth any person's while to do so; possibly it deserves the attention of large land owners and colliery proprietors. The object of this communication is to direct attention to the subject, its attractions and its difficulties, all of which I have endeavoured to state, without any previous bias, in the hope that my opinion may have some value.

ON GEMS AND PRECIOUS STONES.

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I.—Introductory.

Gems have been aptly designated the flowers of the mineral kingdom, and have been highly prized by all nations, whether civilised or barbarous, from the earliest times, not only as objects of adornment, but also as votive offerings, charms and emblems.

It is remarkable that the discoveries of the last few years, which have so greatly extended the lists of the mineralogist, have not added to the family of gems. Although upwards of seven hundred mineral species are now enumerated, the group of the precious crystals has remained the same, and there are but one or two gems known to us with which the ancients were unacquainted.

II.—The Theories and Opinions of the Ancients.

Of such remote origin is the taste for gems that the most ancient historical records bear witness of its previous existence. The Jews adorned Aaron's ephod with jewels, and probably derived their knowledge of precious stones from the Egyptians. The Egyptians themselves engraved various gems in the form of scarabæi, and such are now frequently disinterred with mummies. The conquerors of Mexico and Peru found the Incas and Montezumas in possession of jewels, engraved and carved into various shapes. The records of the Hindoos speak of gems in a manner which

attests the antiquity of that high appreciation of jewels which has always been found to exist among oriental nations.

Pliny mentions that the Indian nations of his day adorned their garments and various utensils with gems, and, in the expression of his own admiration of the group of precious stones, says, that "in them we see all the majesty of nature on a small scale, and that in no other of her works does she present us with anything so admirable."

But it was not for purposes of ornament merely that jewels were so highly valued, and so much sought after. Among all nations there prevailed a superstition ascribing magic and talismanic properties to gems, which caused them to be much coveted. Jewels, of considerable size and lustre, were supposed to confer health and prosperity on their owners, to preserve them in the midst of the most appalling dangers, and even to give them command over the world of spirits. This superstition lingered in England and on the Continent until very recent times, if indeed it is even now extinct. It is not above half a century since diamonds and other gems were borrowed from rich families by their poorer neighbours, to be applied to the cure of local diseases. Care, however, was taken, when the jewel was introduced into the mouth for toothache, or sore throat, to secure it by a string to prevent its being swallowed by the patient.

According to Boetius, in his work *De Natura Gemmarum*, the ruby is a sovereign remedy against the plague and poison; it also drives away evil spirits and dreams. The jacinth, if worn on the finger, procures sleep, and brings riches, honour, and wisdom. The amethyst dispels drunkenness, and sharpens wit. He says of the balas ruby, that it restrains wrath and passion, and preserves from lightning; of the emerald, that it discovers false witnesses, by changing

colour when such persons are before it; of the sapphire, that it procures favour with princes.

Homer mentions that the earrings of Juno contained shining gems; and from the large number of Greek intaglei that are still extant, of turquoise, onyx, and even ruby, it is evident that the Greeks were well acquainted with certain jewels at a very early period. In a poem by Orpheus, or, as some suppose, by Onomacriton, written about 400 years before the Christian era, the supernatural powers of gems, in which the Greeks had implicit belief, are mentioned.

An early Greek writer ascribes to rock-crystal the power of producing the sacred fire used in the Eleusinian mysteries; it was laid upon chips of wood in the sun, when, first smoke and then flame was produced, and this fire was supposed to be most grateful to the gods. It is well known that a large part of the Greek mythology was of Egyptian origin; and as the Priests of Egypt were well acquainted with the use of several scientific instruments, it may be supposed that this tradition arose from the employment of crystal lenses (burning glasses) in the process. Plato and Aristotle were both acquainted with the use of gems. Theophrastus, the disciple of Aristotle, wrote a treatise on the subject, which is still extant. Plato describes the diamond as being found like a kernel in gold, and supposed it to be the noblest part, which had become so condensed as to form a transparent body. Theophrastus, in the work referred to, relates that water is the base of all metals, and earth of all stones; and describes the popular belief in the power of reproduction, which some stones were supposed to possess. He also mentions, that the carbuncles found in Carthage and in Massilia, were bright red, and, when held in the sunlight, resembled glowing coal, which corresponds with the character of the jewels we now designate by the same name.

Although the ancients classed all stones of a similar colour together, as, for instance, under the name of *Carbunculus*, or *ανθραξ*, all jewels of a red hue, and under the term *Sapphire*, all those that were distinguished by a blue tint, this arose rather from their want of chemical knowledge, than from an absence of discrimination of the difference existing between gems that assume a common colour.

The Greeks considered rock-crystal to be a congelation, like ice, and in this opinion Theophrastus, Aristotle, and Pliny concur. They suppose it only to be found in the coldest regions. The emerald pillars of the temple of Hercules at Tyre, the emerald sent from Babylon as a present to a king of Egypt, four cubits in length, and three cubits in breadth, and the emerald obelisk described by Herodotus, were doubtless green jasper, more especially as Theophrastus mentions a specimen which was variously coloured.

Pliny endeavours to account for the infusibility of certain gems, by the hypothesis that they contain no moisture (Book xxxvii., cap. iv.); and he describes a sapphire as 'spotted with gold,' which would lead us to infer that he is describing what is now called lapis lazuli, or aventurine. His classification of gems was upon the principle to which reference has been made, viz., colour. He places the diamond in the first rank, and greatly exaggerates its quality of hardness. He relates that it becomes soft if it be immersed in goats' blood. His treatise is of great value as a *resumé* of ancient opinions, and would appear to have been based upon those of Aristotle, Theophrastus, and Democritus. It is instructive to note that Pliny declaims against the great extravagance of his time, which adorned drinking cups, etc., with jewels.

In the buried cities of Herculaneum and Pompeii, rings have been found with devices engraved on green jasper and chalcedony.

The Romans, after their conquest of Greece and Egypt, appear to have indulged in a lavish display of gems, which was carried to an unparalleled extreme. Lucan mentions the meeting of Cæsar and Cleopatra in a hall of tortoise shell, studded with emeralds, pearls, and topazes. Caligula, in his madness, adorned his favourite horse with a collar of gems. The statues of the gods had eyes made of jewels, just as Idols are still adorned in Eastern countries. The largest diamond in the Russian treasury was formerly the eye of an Indian idol, and was stolen by the Priest.

A particular gem was set apart as the symbol of each month, and the circle or amulet so formed was called the circle of the zodiac stones. The order is as follows —

January -	Aquarius -	Jacinth or Garnet.
February -	Pisces -	Amethyst.
March -	Aries -	Blood-stone.
April -	Taurus -	Sapphire.
May -	Gemini -	Agate.
June -	Cancer -	Emerald.
July -	Leo -	Onyx.
August -	Virgo -	Carnelian.
September -	Libra -	Chrysolite.
October -	Scorpio -	Aqua-marine.
November -	Sagittarius -	Topaz.
December	Capricorn -	Ruby.

Certain stones were also set apart to symbolise the twelve Apostles:—

Peter	represented by the	Jasper.
Andrew	"	Sapphire.
James	"	Chalcedony.
John	"	Emerald.
Philip	"	Sardonyx.
Bartholomew	"	Carnelian.
Matthew	"	Chrysolite.

Thomas	represented by the	Beryl.
Thaddeus	"	Chrysoprase.
James the Lesser	"	Topaz.
Simeon	"	Jacinth.
Matthias	"	Amethyst.

Gems were supposed to indicate the state of health of the donor or possessor. If they became dull, he was conjectured to be unwell, or in danger; the turquoise was supposed to be particularly sensitive, and esteemed accordingly. The fact that some turquoises do change their colour may have given rise to this superstition.

The writers of the middle ages seem to have adopted the ideas of Pliny; and in a book published in 1652, by Thomas Nicolls, at Cambridge, they are quoted at length.

The phosphorescent properties of certain gems were probably discovered at an early period; and in the Brahminic Vedas, a place lighted by rubies and diamonds is spoken of.

III.—The Precious Stones mentioned in the Bible.

In the volume of the Sacred Scriptures there is a treasury of useful information on many subjects. Precious stones, it would appear from its testimony, were not in the possession of the majority of the opulent classes, for, when offerings were solicited for the erection of the tabernacle, it was only the chiefs of the Twelve Tribes that brought the "shoham stones, and stones to be set" (Exod. xxxv. 27).

We find in the 28th chapter of the book of Exodus, and again in the 39th chapter, an important list of the gems with which the ancient Hebrews were acquainted. These are, in the Authorised Version, "Sardius, topaz, carbuncle, emerald, sapphire, diamond, ligure, agate, amethyst, beryl, onyx, and jasper."

TABLE SHEWING THE VARIOUS TRANSLATIONS FROM THE ORIGINAL HEBREW OF THE NAMES OF THE TWELVE STONES WORN IN THE BREASTPLATE OF THE HIGH PRIEST.

No.	Hebrew.	Authorised Version.	Vulgate.	Greek.	Syriac.	Arabic.	Samaritano-Arabic Version.
1	Odem	Sardius	Sardius	Sardion	Sumoko	Jakuth Achmar	Achmar
2	Pitdah	Topaz	Topazius	Topazion	Sorgo	Azphar	Azphar
3	Bareketh	Carbuncle	Smaragdus	Smaragdos	Borko	Samurod	Achzar
4	Nophek	Emerald	Carbunculus	Anthrax	Zadiro	Cochli	Somurod
5	Sappir	Sapphire	Sapphirus	Sapphiros	Saphilo	Mahar al-Ballur	Saha
6	Jahalom	Diamond	Onychius	Onychion	Neketho	Bahraman	Firusg
7	Leshem	Ligure	Ligurius	Ligyrion	Konkenum	Gasa	Gasg
8	Shebo	Agate	Achates	Achates	Karkedno	Sebh	Saych
9	Achlamah	Amethyst	Amethistus	Amethistos	En Eglo	Firusag	Bahraman
10	Tharshish	Beryl	Chrysolithus	Chrysolithos	Thorspish	Asrak	Sorak
11	Shoham	Onyx	Beryllus	Beryllion	Berulo	Ballur	Ballur
12	Jashpeh	Jasper	Jaspis	Jaspis	Jashpeh	Jashaph	Jashm

No. 1.—(Sardius) אֹדֶם. The Hebrew word is capable of denoting the carnelian, the ruby, or any red jewel. The carnelian was very highly esteemed among the Hebrews and the Arabs as a prophylactic, and was supposed to have the virtue of preserving life in times of epidemic sickness. Niebuhr states that it is still employed to stop hæmorrhage. Hebrew legends state that the blushing ruby became the symbol of Reuben, whose character was such as to induce a blush.

No. 2.—(Topaz) פִּטְדָה. The name is derived from the Island Topazion. There are two kinds of topazes; the best sort are of a golden colour, and the other variety partakes of a greenish hue (chrysoprase).

No. 3.—(Carbuncle) בָּרֶקֶת, literally meaning flashing, probably derived from "barak," lightning. An Eastern legend states that a carbuncle was suspended in the ark of Noah to diffuse light. There was an ancient belief that some of the most brilliant gems were dropped from the clouds during thunder storms.

No. 4.—(Emerald) נֹפֶךְ. The Hebrew name signifies "carbuncle." This gem belongs to a very numerous class; the colour was supposed to be that of glowing coal. The most brilliant stones were termed *males*, and the duller ones *females*; a distinction that was assigned by ancient lapidaries generally.

No. 5.—(Sapphire) סַפִּיר. This stone is frequently mentioned in the Bible as being of exquisite beauty; and there is a tradition that the decalogue was inscribed on tables of sapphire. It is the only gem of whose identity we may feel tolerably certain, and which has preserved its original name.

No. 6.—(Diamond) יָהֲלֹם. This word is derived from the Hebrew verb "halam," to strike, and has reference to the great hardness of the diamond.

No. 7.—(Ligure) לֶשֶׁם. This gem is supposed to be the turquoise. The following anecdote, quoted from an old treatise on precious stones, will illustrate the value which superstition assigned to this stone:

"One of my relatives possessed a turquoise set in a gold ring, which he used to wear on his finger as a superior ornament. It happened that the owner of this ring was seized with a malady of which he died. During the whole period in which the wearer enjoyed his full health, the turquoise was distinguished for unparalleled beauty and clearness; but scarcely was he dead, when the stone lost its lustre, and assumed a faded, withered appearance, as if mourning for its master. This sudden change in the lustre of the stone made me lose the desire I once entertained of purchasing it, which I might have done for a trifling sum, and so the turquoise passed into other hands. However, no sooner did it obtain a new owner, than it regained its former exquisite freshness, and lost all traces of its temporary defects."

No. 8.—(Agate) שְׁבוֹ. Rabbinical translation, hyacinth.

No. 9.—(Amethyst) אַחְלָמָה. Rabbinical authors consider this to be the onyx. Some mediæval writers sought to find a scriptural basis for current superstitions by connecting the name with the verb "chalam," to dream.

No. 10.—(Beryl) תַּרְשִׁישׁ. The usual rendering is chrysolyte.

No. 11.—(Onyx) שֹׁהַם. Rabbinical translation, emerald.

No. 12.—(Jasper) יָשְׁפֵה. This stone is remarkable for its wide distribution, and the general appreciation in which it was held.*

IV.—The Properties and Characteristics of Jewels.

1.—*Hardness*, which means, not difficulty of breakage, but power of resisting the mechanical pressure of another body in contact, or, in other words, liability, or non-liability, to be scratched. This quality of hardness gives to a jewel its susceptibility of receiving and retaining a fine polish. There are three principal tests of hardness:

1. Capability of scratching glass.
2. Capability of scratching rock crystal.
3. Capability of scratching topaz.

The diamond scratches everything. Peridot and opal scratch nothing, not even bottle glass.

2.—*Lustre or Brilliancy*. This quality is either—

Adamantine—possessing the brilliancy of the diamond;
Vitreous—resembling the surface of glass;
Resinous—shining, as if rubbed with oil;
Pearly—exhibiting the lustre of the pearl; or
Silky—like the gloss of silk.

3.—*Colour*. This quality affords a very imperfect means of determining the identity of a gem; many jewels, of most divergent natures, often possessing the same colour. But it is the most important commercial quality, for unless a jewel is of the proper colour, size, hardness, lustre, etc., it is of little value. The colouring matter is generally found to arise from the presence of some metallic oxides. The colours exhibited by precious stones are the most brilliant

* I am indebted for some of this information to my kind friend, Professor Prag.

with which we are acquainted, except those of the solar spectrum, which they resemble.

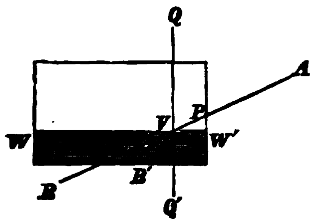
The colour of a gem frequently changes its commercial name and value, *e. g.*,

The red sapphire is a ruby.
The yellow sapphire is a topaz.
The white emerald is a beryl.
The green chrysolite is a peridot.

It frequently happens that a single specimen displays several colours; the oriental sapphire has been found coloured red, blue, and yellow, in different parts of the same crystal.

4.—*Optical Properties.* These are several in number; the most important being single and double refraction.

Single Refraction. When a ray of light falls obliquely on the surface of any transparent body, it is bent or refracted from its original course; thus, suppose a closed box, having

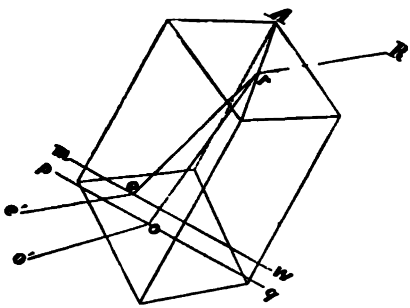


an orifice at P; let A be a luminous point, as a candle. If the box were empty, a ray of light would travel in such a line as A–B; but if we fill a portion of the chamber with water = $W - W^1$, then the ray would not travel on to B, but would be refracted to such a point as B^1. We thus get the angle of incidence A V Q, and the angle of refraction B^1 V Q^1.

The sine of the angle of refraction has a fixed ratio to the sine of the angle of incidence; the ratio is the "Index of refraction."

Single refraction is common to all bodies, whether crystalline, amorphous, or fluid; but some crystals have a remarkable property, by means of which a ray of light is divided in its passage through them, and each of the two rays which issue forth pursue different paths. This property is called—

5.—*Double Refraction,* and will be easily understood by a reference to the following diagram, which represents a crystal of Iceland spar.



The ray of light *R* is separated, one part, *r o o*[1], pursuing the ordinary path, while the other ray, *r e e*[1], travels in a different or extraordinary course.

6.—*Polarisation of Light.* By this term is meant that peculiar modification which a ray of light undergoes, in consequence of which, its capability of being transmitted or reflected towards particular sides is wholly or partially destroyed. The phenomenon is beautifully exhibited by some gems, and it becomes a valuable test of a jewel's identity.

It is to the researches of Biot, Haüy, Huygheus, Fresnel, Wollaston, and Brewster, in the departments of mineralogical optics, that we owe our knowledge of some of the most beautiful phenomena with which we are acquainted.

7.—*Specific Gravity.* The methods adopted to ascer-

tain the specific gravity of a body are too well known to need any description; the apparatus used, though simple in its conception, is so delicate that the specific gravity of a jewel, being accurately determined, it becomes one of the most valuable tests of its identity.

8.—*Electrical Properties.* Some crystals become electric by pressure: Iceland spar, for instance; the topaz, amethyst, and all quartz jewels do so to some degree. In some bodies this quality is developed by heat. The tourmaline derives its Dutch name, "aschentrekker," from its alternately attracting and repelling hot ashes. The garnet, diamond, topaz, and emerald all possess pyro-electric qualities. Some gems become positively electric by friction. Among others, the diamond has this property.

9.—*Diaphaneity.* The following terms are made use of to describe the different degrees of transparency:

Transparent,
Semi-transparent,
Translucent,
Semi-translucent, and
Opaque.

They need no explanation.

10.—*Fusibility.* Most precious stones are infusible, or fusible only with difficulty, by means of fluxes, such as borax.

The diamond is infusible, although combustible. The true ruby, sapphire, emerald, &c., are fusible, but with difficulty. The application of heat to precious stones produces in some a change of colour, in others globules, and in others an enamel; while some burn, and some become phosphorescent.

V.—The Diamond.

This peerless gem is always placed in the first rank. I

is the most brilliant of all jewels, and the hardest of all substances. The Greek name of the diamond, αδαμας, has reference to its quality of hardness; and in ancient literature the most fabulous stories were told of its solidity. It was said that a diamond might be placed upon an anvil and struck with a hammer without sustaining injury; and, if the blows were forcible enough, the hammer might be broken, or the diamond would bury itself in the iron of the anvil. The fact being, that, though the diamond is the hardest of all known bodies — in the sense that has been defined (*supra*), it is easily broken by percussion, and the *laminæ* of the crystal, which are generally visible, form planes of cleavage along which it is split with facility.

There is a peculiarity about the crystals of the diamond which produces a concave figure in some instances, and a convex one in others. And it is those specimens that possess naturally rounded edges that are alone serviceable for the humble purposes of the glazier, and for many other useful appliances; though all fragments of this prince of gems are turned to good account. Small drills are made either of imperfect diamonds, or of fragments split off good stones in the process of cutting. They are used for drilling small holes in rubies, and other hard stones, for use in chronometers, etc., for piercing holes in china, or in other hard substances.

Diamonds are also used for arming the end of the borer in a new rock-boring machine, which has proved an efficient excavator of the hardest rocks, such as granite and porphyry.

The use of diamond-dust, too, has increased of late with the demand for such articles as Cameos and Intaglios, which are fashioned by its means.

The natural crystals of the diamond are generally of the octahedron and dodecahedron types, though it also occurs in an amorphous form. In its rough state, it is usually

devoid of brilliancy, and semi-transparent, having some resemblance to gum-arabic.

The extraordinary brilliancy of the diamond is attributable to its enormous refractive power and its very minute dispersion of light. Newton was led by his observation of its optical properties to place the diamond among combustible bodies, but the first to prove the truth of this conjecture was Cosmo III., grand duke of Tuscany, who exposed some specimens to the action of the powerful burning-glass of Tschêrnhausen, and saw them vanish in a few moments into air.

Some French chemists burnt a fine diamond in an assayer's furnace in 1771, but it was not decided whether the gem was really burnt, vapourised, or dispersed in impalpable atoms. A French jeweller, however, Maillard, declared that he had frequently exposed diamonds to heat as intense, without any injury resulting, and offered to repeat the experiment. He embedded some diamonds in charcoal powder, and sealed them hermetically in a clay pipe bowl, then placed them in the furnace for twenty-four hours, and when they were taken out they were found to be uninjured; thus solving the problem, and shewing that the diamond, like other combustible bodies, only *burns* when in combination with oxygen. But the catalogue of such destructive attempts does not end here. Lavoisier burnt a diamond in pure oxygen, and obtained as a result, carbonic acid. Another chemist, Clouet, made steel by exposing iron and diamond together. These experiments show that the result of combustion is the same as that of pure carbon, and that the diamond is allied to other carboniferous bodies.

It was early proposed to apply the diamond to optical purposes, but lenses made from it do not appear to have answered the expectations that were formed. Sir David Brewster has demonstrated that the irregular structure of

the crystals, to which reference has been made, unfit the diamond for this purpose, causing such an excessive aberration of light as to interfere with the optical efficiency of the lens.

Although generally colourless, like pure rock-crystal, different specimens present every variety of tint, from roseate hue to crimson red, or from pale yellow to dark green and blue, or even black. Colourless diamonds are in general most highly esteemed, but coloured stones are sometimes of most exquisite beauty, and of corresponding value. The blue variety is exceedingly rare; and one, the celebrated 'Hope' diamond, weighing 44½ carats, and of a charming sapphire blue, is valued at £25,000.

The art of diamond cutting is supposed to have originated with Louis van Berguem, at Bruges, in 1450. Before his time the diamond had never been cut into true facets, and was not esteemed so highly as some other jewels, which were easily cut and polished by the lapidary. In the operation of cutting, the natural crust is removed, and the stone is fashioned into the required shape. Two rough diamonds are taken, which are fastened into two sticks, the tops being filled with cement, into which each diamond is inserted, leaving exposed the part to be cut. The workman, who has leathern gloves on his hands, as well as a leathern stall on his right thumb, takes a stick in each hand, and, rubbing them together, a facet is produced in each stone, instead of the natural concave or convex figure. It is only the general outline of the crystal that is thus made; it is from the next process that the diamond will receive the larger number of small facets, and its fine polish. The second process, called the polishing one, is effected by means of a horizontal plate, ten inches in diameter, called a 'schyf,' or mill, which is made to revolve with a velocity of 2,000 or 3,000 revolutions per minute. The surface of this 'schyf'

is rubbed with an ordinary whetstone, in such a direction as to form tangents of a circle, whose diameter is about one-third of that of the 'schyf.' By this means the whole surface becomes covered with deep scratches. Then a fine hone or turkey-stone is rubbed over again in the direction of the diameter, until the former marks are nearly obliterated, and by the crossing of the scratches a kind of soft grain is formed, which makes the 'schyf' fit to retain the fine diamond powder, which is then rubbed upon it mixed with oil. The flat surface of a finished diamond is then held against it whilst in motion, and thus the powder is forced into the minute cavities of the revolving disc. The diamond to be polished is then inserted into a stick, having a handle made of brass, with a hollow top filled with solder, into which the diamond is pressed, whilst the solder is soft, and then allowed to cool. The diamond, thus fixed, is pressed upon the 'schyf,' and is ground into the required shape. The solder has to be melted and the diamond re-fixed for grinding each facet. When we think of the minuteness of some of the facets required to be produced on small diamonds; and of the immense value of the larger stones, which a careless workman might spoil, it is apparent that the work is one requiring great skilfulness.

A rude method, by which diamonds received a small degree of polish and form, was early practised in Europe, though not well known.

The mantle of Charlemagne has four large diamonds upon its clasp, which are in the rough state.

For about four hundred years, Amsterdam and Antwerp have maintained the first rank in the art of diamond cutting; an art which it might have been supposed would have found a more appropriate seat in London or Paris, the centres of our modern wealth and fashion.

Diamonds are usually cut as Roses or Brilliants.

The *Rose* diamond is flat underneath, while the upper surface, which is covered with a great number of facets, rises in a dome shape. The object in having so many facets is, that the light reflected from the large flat under-side, may be caught at various angles, and so refracted that it may produce the most beautiful prismatic effect.

The Koh-i-noor was cut as a rose diamond before it was presented to the Queen, when it weighed 186 carats. In re-cutting the gem as a brilliant, the weight was reduced to 103 carats.

The *Brilliant* is the style generally preferred. A Brilliant must be three times the thickness of a rose diamond. It is cut into facets, but so as to form two pyramids rising from a central base, or *girdle*, as it is technically termed. Each pyramid is truncated at the top by a section parallel to the girdle, which cuts off 5–18ths of the whole height from the upper, and 1–18th from the lower pyramid. The superior plane thus produced is called the *table* ; and the lower one, the *collet*. The light, entering through the larger upper surfaces, strikes the smaller lower ones, and is reflected back, traverses the side facets, is refracted, and so produces prismatic effects. In executing the brilliant, there are formed thirty-two faces of different figures, and inclined at different angles all round the table; while around the collet there are twenty-four other faces.

It is essential that the faces of both table and collet sides should correspond in sufficiently exact proportion to multiply the reflections and refractions, and so produce the gorgeous display of prismatic colours which render the brilliant diamond pre-eminently beautiful.

The most anciently renowned diamond districts are situated in the Indian Peninsula, in the kingdoms of Golconda and Visapour, extending from Cape Comorin to Bengal, at the foot of the chain of the Orixa Mountains.

These mountains are of volcanic rock — probably Trappean in its nature. Tavernier describes the mines as giving employment to thousands of workmen, but they are now almost exhausted.

We are but little acquainted with the diamond districts of Landack, Borneo, though Ida Pfeiffer, on her second voyage round the world, obtained permission to visit them, a privilege seldom accorded to Europeans. Very few of the diamonds of Borneo find their way to us; they seem to be bought up for India.

Brazil furnishes many beautiful gems. When diamonds were first discovered in the Serra do Frio, in the beginning of the 18th century, the real value of the glittering crystals was so little known, that they were made use of as card markers, by the planters. An Inspector of mines, who had been some time in India, was the first to discover their true nature. He kept the secret to himself, and collected a large number, when he departed with his treasure to Europe. In 1729, the Governor of the Brazils, Don Lourenzo de Almeida, sent some specimens to Lisbon, and thus the attention of the Spanish Government was called to the matter. In 1730, a decree was issued, which placed the diamond districts under the rule of an Intendant, armed with the most arbitrary powers. Despotism exerted all her energies for the purpose of securing to the crown the monopoly of the costliest of gems. But, notwithstanding all the stringent measures that were enacted, it was impossible to prevent a contraband trade being carried on; and the audacity of the smugglers increased with the obstacles that were placed in their way. It is said that by far the larger number of the diamonds that found their way into Europe were secretly come by. Traversing the deep forests, on almost inaccessible mountain paths, the bold free traders met, at some place of appointment, the negroes who had

succeeded in secreting some of the precious stones, and paid them a trifle for diamonds, which were worth many times as much as was given. The heaviest penalties could not prevent the inhabitants of the Serra from defrauding the crown; and Herr von Tschudi (*Travels, South America*, 1857–61) was told many amusing instances of their smuggling contrivances. One of them had concealed a diamond of 25 carats in his riding whip, for which purpose he had practised for many weeks the art of plaiting the thin leather straps which covered it.

The Brazils afterwards becoming an independent country, the monopoly of the diamond trade was abandoned by the new government, and liberty to search for gems was acceded to all who paid the slight duty imposed.

The formation of the diamond in nature is one of the many problems that our philosophy has not yet solved. Nowhere do we find the diamond in its true matrix. In Brazil, the diamonds are chiefly found in alluvial deposits—*Cascalho-virgem*, in the beds of torrents, or along low river banks. Frequently large quantities of overlying *debris* have to be removed before the diamondiferous strata is reached. According to Heyne, it is also the alluvial deposits of India that are richest in diamonds. A section of the Golconda district, would exhibit—

α. Sand or gravel, 18 inches in thickness.

β. Stiff black clay, 4 feet in thickness.

γ. Diamond bed with numerous boulders, 2½ feet in thickness.

The Brazilian Cascalho is composed of granite detritus, with broken mica slate, quartz pebbles, and sand. Gold is found in it.

The diamondiferous deposits of South Africa closely resemble the Indian and the Brazilian beds in their character The diamonds are found in the midst of

gravel, consisting of fragments of granite and palæozoic schists.

The question — What is the true matrix of the diamond? cannot at present be answered. Strata of hypogene and palæozoic nature are both suggested; and diamonds have been found in the quartzose rock called "Itacolumite," and in certain schists associated with it.

Itacolumite occurs in Brazil, the Ural Mountains, Georgia, and North Carolina, and in all these places diamonds have been found. If cut into thin slabs, it is transparent and flexible.

Formerly most of the Brazilian diamonds were found in the district of Tejuco, the capital of which, in 1831, received the very significant name of Diamantina. In 1844, however, new mines were discovered in the Serro do Sincora, in the Province of Bahia, whose richness eclipses that of the most brilliant times at Tejuco.

The diamond is rarely found exceeding 10 carats in weight. Such specimens are termed *princely*. It is estimated that only one princely gem will be found in ten thousand specimens. Above 20 carats, there are fewer still; and only five diamonds are known to exist weighing over 100 carats. To these the name of *Sovereigns* has been given.

The largest of these is the magnificent gem, of the first water, without fault or blemish, belonging to the crown of Russia. It weighs 194 carats, and came from India. It once adorned the throne of Nadir Shah, and when that tyrant was murdered it was stolen, and eventually purchased by the Empress Catharine II.

The second of these is the Pitt diamond. It came into Mr. Pitt's possession while Governor of Madras. He sold it to the Duke of Orleans for £135,000, having paid £12,500 for it. It is also an Indian gem. Its original weight was 410 carats, but it was reduced to 137 carats in cutting,

which operation it took two years to accomplish. It is now among the French jewels, and is known as the *Regent.*

The third of the *Sovereigns* is the diamond of Tuscany. It weighs 140 carats. It once belonged to Charles the Bold of Burgundy, and at the battle of Nancy a trooper plucked it from the helmet of the unfortunate duke, and sold it for a crown. It is now the finest jewel of Austria.

The fourth and most celebrated of these diamonds is the Koh-i-noor. According to Hindoo legend, it was worn by one of the heroes of the Great War, which took place about four thousand years ago. After numberless vicissitudes and peregrinations among the Great Moguls, in 1739 it came into the possession of Nadir Shah, who, on his occupation of Delhi, compelled Mahomed Shah, great-grandson of Aurungzebe, to give up to him all the Imperial treasures. According to tradition, Mahomed Shah was imprudent enough to wear the Koh-i-noor in his turban, at his interview with his conqueror, who, being

> "the mildest-mannered man,
> With all true breeding of a gentleman,"

insisted on exchanging turbans in proof of his regard, and is said to have bestowed upon the diamond, thus politely annexed, the name of Koh-i-noor. After the fall of his dynasty, the stone became the property of Ahmed Shah, the founder of the Abdali dynasty of Kabul, and, when Mr. Elphinstone was at Peshawur, was worn by his successor, Shah Shuja, on his arm. When Shah Shuja was driven from Kabul, he became the nominal guest, but actual prisoner, of Runjeet Singh, who, following the good example of Nadir Shah, *gently* persuaded his protegé to part with his diamond for the revenues of three villages—not one rupee of which he ever realised. "By what do you estimate its value?" asked the Sikh Maharajah of his victim, as the

surrendered Koh-i-noor rested on the arm of its new master. "By its good luck," said Shah Shuja; "for it hath ever been his who hath conquered his enemies." Subsequent events fully proved the truth of this remark; for when the Punjab was annexed by the British Government, it was stipulated that the Koh-i-noor should be presented to the Queen of England. But, in spite of its promising name, it was of inferior lustre,—for the Orientals are poor hands at diamond-cutting,—and it had to be re-cut. Amsterdam lapidaries came over to England for the purpose, and the operation, which was conducted with the assistance of a small steam-engine, cost £5,000. Though the Koh-i-noor was reduced in weight from 186 carats to 102 carats, its present weight, it gained in lustre, and fully deserves the poetical name it bears.

The four sovereign gems that have been referred to all came from India; but latterly they have been rivalled by a Brazilian stone, of great beauty, originally weighing 255 carats, but reduced in cutting to 125 carats—the "Estrella do Sul." It has brought good luck to none of its possessors. An old negro woman found it accidentally, in a diamond mine, at the Rio de Bagagem, in Minas Geraes, among a heap of pebbles that had previously been examined. She gave it to her master, who did not even reward her, as is customary, with her liberty. This man was in needy circumstances, and had been allowed by the proprietor of the mine, for a small sum, to search for diamonds with his few slaves. The proprietor now claimed the diamond, alleging that, as it had not been found in the premises hired by the tenant, it rightfully belonged to him. A law-suit ensued, profitable only to the lawyers. To be able to defend his cause, the possessor pawned it to the Brazilian Bank, for £8,000. Though life is short, law-suits are long; and the poor man died, leaving little property behind. After passing

through several hands, it was bought by a Dutch jeweller, at Rio, who, to pay for it, and the expense of cutting, had to borrow largely, at the usual high rate of interest. The cost of cutting was £4,000. The question now was to find a purchaser. Several crowned heads were applied to, but declined. No royal wedding, or one of high rank, was allowed to pass, without its being offered for sale, but all efforts to dispose of it were fruitless; and I have not heard of it having even yet found a purchaser.

It seems that monarchs, now-a-days, are of opinion that the enormous sums formerly paid for diamonds may be invested more profitably. The Dutch jeweller is said to have died of a broken heart, leaving his jewel in the hands of a commercial house in Paris, who will probably keep it, as the interest accumulating will absorb its value.

The Portuguese Crown possessed, a few years ago—perhaps it still does—the richest collection of diamonds in the world. The value of £3,000,000 has been assigned to them.

One large uncut stone, of 1,680 carats weight, which was formerly supposed to be a diamond, is now known to be but a white topaz.

In 1863, it was resolved, with the consent of the Cortes, to sell the uncut jewels that were contained in such immense quantities in the vaults of the Bank of Lisbon, and invest the proceeds in the Civil Funds.

The value of the diamond is, in England, about £12 for a brilliant of 1 carat, and £8 for a rose of the same weight. The value of larger stones is calculated by multiplying the square of the weight in carats by 12 or 8, except for diamonds of 20 carats, or more, the values of which are quite arbitrary. The enormous value ascribed to large diamonds is, however, merely fanciful, for they are worth neither more nor less than what purchasers will give.

VI.—Other Precious Stones.

It will be convenient to arrange the various jewels of of which I shall speak as *minerals*.

The Silicon group, as the largest and most important, may be placed first.

I. Silica, in its pure form (an oxide of silicon, or silicic acid), is very common in granite and other hypogene rocks, and in volcanic fissures. It is also abundant in metalliferous veins, &c. As *Quartz* or *Rock Crystal*, it presents a six-sided prism, terminating at one or both ends in six-sided pyramids. The size of the crystals varies very much. Some are minute, while others attain to four feet or more in length. The lustre of quartz is vitreous. Some kinds are transparent, others are opaque. It may be found colourless, red, yellow, brown, violet, or black. The specific gravity of all the members of this family varies from 2.5 to 2.8. The refraction is double, and it becomes positively electric by friction. The chemical composition is pure silica or—

Silicon, 48.04.
Oxygen, 51.96.

i. *Rock Crystal.* The first variety of vitreous quartz is the colourless one, called rock crystal. The crystals are extremely beautiful. It is found in almost every part of the globe. Every one is familiar with it as the "pebble" of the optician. It is particularly adapted for use in spectacles on account of its hardness and coldness. Lenses must, however, be cut at right angles to the axis of the crystal, in order to avoid the effect of double refraction, which would not only be unpleasant, but injurious to the eyesight.

It was an ancient belief that a cup made of rock crystal would become discoloured if poison was placed in it. Consequently goblets fashioned out of it were highly esteemed. Nero is said to have possessed two such cups, elaborately

ornamented, which he destroyed that no one else might drink out of them. It was frequently used as a medicine when powdered and mixed with wine.

The *Amethyst*, or violet coloured variety of quartz, was anciently prized as a specific against drunkenness. As an instance of the value that was assigned to it, we read that in 1652 an amethyst was worth as much as a diamond of the same weight. Heintz obtained from a Brazilian amethyst—

Oxide of Iron .	0.0187.
Lime . . .	0.6236.
Magnesia . .	0.0133.
Soda . . .	0.0418.

Smoky Quartz is grey or brown; *Cairngorm* is yellow, either of a pale or rich amber tint; and smoky quartz when burnt may be changed into cairngorm. False topaz is another name that is applied to cairngorm when it is of a particular hue. The practice of giving a separate name to every variety of a crystal which exhibits a distinct tint has led to great confusion in nomenclature. Jewellers and others, who are utterly regardless of mineralogical differences, class under one name gems of totally different natures.

Aventurine is the pearly-grey variety of quartz. It contains minute spangles of mica, which give it a glistening appearance.

ii. Silica in a crystalline form, not shewing definite crystals, occurs as *Chalcedony* in a great variety of conditions.

Agates are formed of chalcedony, carried by infiltrating water through porous volcanic rocks, lining and filling the oval cavities in lavas and amygdaloidal rocks, with concentric layers of this silicious mineral, either by itself or associated with quartz. The agate, when cut and polished, shews various layers; but if these be artificially coloured,

darker tints may be produced than exist in the natural stone; and greater contrasts are produced in the sliced agate, and in the cameo or gem, engraved out of a series of parallel layers.

Thus are produced *Onyx*, *Sard*, and *Sardonyx*, according to the number of layers exposed in the carving and the tints exhibited. *Carnelian* comprises white and red varieties of the flat layers of agate, sometimes artificially coloured by burning. Chalcedony is also the substance of *Mocha stone* and *Moss agate*, which have been formed in rock cavities, probably by volcanic agencies. Sometimes the interior of Flints, where decomposed sponges have left cavities, have been filled with chalcedony. The beautiful dendritic filaments of Mocha stone, etc., are probably due to the presence of cracks in the chalcedony, through which oxides of iron and manganese have infiltered and become dispersed through the mass.

Solid green chalcedony, in different conditions, supplies *Plasma*, *Prase*, *Chrysoprase*, etc.

Cat's Eye is also a variety of silica, more or less chalcedonic. It is variable in colour and transparency, and with fibres of asbestos or amianthus in its substance, which give it, by reflection, a peculiar opalescent appearance and lustre. Ceylon supplies the best cat's eyes, but they occur in many parts of the world.

Chalcedony is a variety of quartz. According to Fuchs it is pure quartz, with opal disseminated through it. It is never found crystallised. The colour varies; it is semi-transparent, translucent, and as hard as quartz.

The *Chalcedonyx* is a variety of chalcedony, having alternate stripes of white and grey. *Plasma* is only faintly translucent. It was anciently much esteemed for engraving upon.

The cutting, polishing, and grinding of the chalcedonic

stones is chiefly carried on in the small towns of Oberstein and Idar. As early as the fourteenth century the art was introduced into the remote valley in which these towns are situated. It appears to be of Italian origin, and was a very rude process until about eighty or a hundred years ago, when the industries of these two small towns received an impetus, which has continued up to the present time.

No stones are so porous, or so easily coloured by artificial means as the varieties of chalcedony. In ancient times the onyxes from Nerbudda were "baked in ovens"; and to this day, in the neighbourhood of Brooch, the nodules of onyx, dug in the dry season from the beds of torrents, are packed in earthen pots, with dry goat's dung, which is set on fire. By the baking process the grey or dark green iron hydrate, which permeates their pores and gives them a dull colour, is changed into the *red oxide*, which imparts to the stones rich hues of orange and hyacinth red; and the more mottled of the onyxes that come from Cambay are thus artificially beautified. Some agates consist of impermeable white bands or layers, alternating with others of a dull colour and of a porous nature. When placed in honey, and exposed to a moderate heat for some eight or ten days, the saccharine matter penetrates into the microscopical pores. The stones are then boiled in oil of vitriol, which, carbonising the honey, imparts a deep black colour to the porous layers which it had permeated, and, by thus setting off the white layers to the best advantage, changes a previously almost worthless stone into a beautiful onyx or sardonyx.

By other chemical processes, some of which are kept secret, rich yellow, or apple green, or blue tints are imparted to the rough stones, and most beautiful contrasts are produced.

iii. Of the *Jasper* varieties of Silica, opaque and variously coloured, several are due to the metamorphic change of

clay beds into impure silex; and others are compact forms of chalcedony.

The jasper is found of various colours: dark green, red, brown, yellow, greyish, and black. It is very hard, and takes a fine polish. Those varieties that exhibit *stripes* are called *ribbon-jasper*.

This stone was anciently much used for cameos, which were so cut as to bring out the differently coloured layers as would be most appropriate to the design.

The *Blood-stone* or common *Heliotrope* is another variety of jasper.

iv. *Opal.* This is an amorphous, and somewhat hydrated variety of silica, related to chalcedony; it is usually milky and translucent, and flecked throughout with patches of red, green, and golden colour, caused by light being refracted by numerous fine fissures traversing the infinitely delicate laminæ of silica.

When soaked in water the beautiful play of colours is lost.

The stone may be milk-white, red-brown, lilac, green, pearl-grey, etc., in colour. Its lustre is vitreous or resinous. It is very brittle.

There are many varieties of opal that have not the peculiar play of colour called opalescence; some are more translucent than chalcedony, and others less so, such as *Semi-opal*, *Honey-opal*, *Menilite*, etc. These are really impure varieties of silica, passing into chalcedony and flint on one hand, and into jasper on the other. *Wood-opal* is a kind of chalcedony, and much like semi-opal; it constitutes the petrifying silica of fossil wood in Hungary, Tasmania, etc.

Pliny says of the opal that "In it we admire the fire of the ruby, the brilliant purple of the amethyst, the lustrous green of the emerald, all shining together in a wondrous mixture."

The finest known specimen is in the Mineralogical Cabinet at Vienna. It exhibits a most magnificent and varied combination of tints, and weighs seventeen ounces.

The specific gravity of the opal is 1.9 to 2.3. It is not found in crystals.

The beautiful and varied tints that some specimens display are due to the decomposition of light. The surface of such an opal is covered with minute striæ, and the prismatic effect produced is the same as that which causes some insects to exhibit vivid colours, though possessing a colourless epidermis.

Those opals that have the greatest play of colours are termed "harlequins."

The Senator Nonius is said to have possessed an opal of rare and exquisite beauty, and to have prized it very highly; preferring banishment with his beautiful gem, rather than surrender it to Mark Antony.

Those gems, of whatever kind, whose beauty has endeared them to their possessors, as in this instance, are termed "stones of affection," and many instances are recorded of sacrifices made, and hardships endured, for the purpose of keeping possession of such beautiful gems.

Before the art of diamond cutting was practised in Europe, the opal was the only gem which, receiving white light, separated it into its constituent rays; and it may be said to have been, and still is, a stone of general affection.

II.—The Aluminium Group.

i. The first portion comprises the Sapphire, Ruby, Corrundum, etc.

These are various conditions of pure *Alumina* crystallised as six-sided prisms; harder than everything except the diamond.

The clear and beautiful blue tints of the *Sapphire*, and

the lovely rose-red of the *Ruby*, render them far more beautiful than the ordinary varieties of corrundum, and the impure species known as emery, which is massive alumina, combined with oxide of iron.

The specific gravity of Precious Corrundum is 3.9 to 4.1. It is susceptible of electricity by friction. Its refraction is double.

All the precious corrundums are identical in every particular except colour. Thus, red corrundum, is ruby; blue, is sapphire; yellow, is topaz. These gems are generally distinguished by the epithet *Oriental* being prefixed.

The crystallisation is rhombohedral, with basal cleavage. In other words, the crystal breaks across the prism with an even surface.

The lustre is vitreous. Occasionally specimens are found asteriated, or possessing a star-like image in the centre of the prism.

Often a single crystal exhibits various colours; it may be blue at both ends, and white and red in the centre. The colours sometimes intermingle.

Where rubies and sapphires are found, gold is sure to be met with. The stones are usually found in layers of sand, or the beds of rivers and streams; but never in a *transparent* crystal in any rock matrix.

The *Oriental Ruby* is the most valuable of all gems when of a large size and free from defects. Such specimens exceed the diamond in value. Its chemical analysis is:—

Alumina - -	98.5.
Oxide of Iron - -	1.0.
Lime - - -	0.5.

Minute rubies of a red colour, and of precisely the same form of crystallisation as the Oriental ruby, have been artifically produced, by heating alumina for a long period with borax, in a platinum vessel. The borax first dissolves the

alumina, and then the elements of the borax separate and volatilise, leaving the crystallised alumina.

Coloured crystals of alumina have also been produced by bringing fluoride of silicon into contact with the vapour of boracic acid, at a high temperature, when mutual decomposition ensues, fluoride of boron escapes, and alumina crystals remain.

It is instructive to note that, under identical circumstances, the colour of the crystal produced is not always the same. In one experiment we have a red crystal, and in another a blue one, resulting. This corresponds with what we observe in nature, both the sapphire and the ruby crystals being found together.

The *Oriental Sapphire*, as already mentioned, is precisely the same stone as the ruby.

The blue tint is seldom spread throughout an entire specimen, and, though a fleck of red may be imperceptible by day, candle light brings out all such imperfections. Another means by which discoloured, or uncoloured parts of a stone may be perceived, is to hold the specimen in a small forceps, about an inch below the surface of clear water.

From what has been said of the ruby, it will be inferred that, like it, the sapphire is found of all tints of blue. The *desideratum* is to procure a specimen that will look as well by candle light as by day.

The name 'Sapphire' is, perhaps, the only name of a gem that runs through all languages with very slight variation.

The *white* sapphire (white precious corrundum) is so like the diamond as often to be mistaken for it. The difference can, however, be easily detected, by taking the specific gravity, or by testing any of its other properties. Its refraction, for instance, is double; and the diamond is the only colourless gem that possesses single refractive proper-

ties. The simplest way in which to apply this test is, to pierce a hole in a piece of card, in which the specimen must be placed; and in looking through it at a small object, such as the point of a needle, if it appears single, the gem is undoubtedly a diamond, but if two objects should be seen, then it is some other jewel.

There are one or two other, and rarer, varieties of corrundum sometimes to be met with, which are distinguished according to their colour, as—

Oriental Amethyst,

Oriental Emerald,

Oriental Topaz, etc.

The green variety, or oriental emerald, is the rarest of all gems. Only one or two specimens are known to exist.

ii. *Turquoise* is a phosphate of alumina—opaque, blue, or bluish green. It is of about the same hardness as felspar, and therefore susceptible of polish, though easily worn rough.

It is found in small concretionary masses, and thin veins, in sandstone, in Arabia Petræa, Persia, etc.

A substance much like turquoise, but essentially different in its character, called *Odontolite*, is found in Languedoc. It consists of fossil ivory, tinted with copper.

iii. Silicates of Alumina.

Kyanite is a silica of alumina, prismatic, translucent; often of a delicate blue tint; not very hard. It is a schistose mineral.

Garnet consists of silicate of alumina, with other silicates. The *Lime Garnet* and *Cinnamon-stone* have the silicate of lime; the *Magnesia Garnet*, that of magnesia. The *Iron Garnet*, including *Almandine*, or *Precious Garnet*, and *Common Garnet*, have the silicate of iron; *Spessartine* contains that of manganese; *Colophonite*, etc., those of iron and

of lime. *Ouvarovite, Pyrope,* and *Carbuncle* contain silicates of lime and of chrome.

Garnet crystallises in rhombic dodecahedrons and other cubical forms. It occurs of different colours — white, green, yellow, brown, red, and black. Most of its varieties are harder than quartz; and, when of good colour, and free from flaws, are valuable. They are found in greenstone, mica-schists, granite, and dolomite.

On account of its brilliant colour and hardness, this gem is much used in jewellery.

Its specific gravity is 3·5 to 4·3. Its lustre is vitreous. It is susceptible of positive electricity by friction. The chemical analyses of the several varieties differ in one or two particulars. All possess silica and alumina.

The term "Carbuncle" is applied to garnets, when they are cut *en cabochon,* or "tallow-topped," which means cut, not in facets, but with a flat or hollow base, and a smooth convex top.

The garnet's refraction is single, and the white or colourless varieties have been used for microscopic lenses.

iv. *Emerald* is a silica of alumina and glucina, with traces of magnesia, soda, etc. It is harder than quartz, of a beautiful green colour, and is transparent. It is very brittle. It is found in metamorphic rocks of the Cretaceous age in South America, and in other strata at Ekatrienburg, Siberia; and in Peru and Russia.

Beryl comprises the bluish, yellowish, or colourless varieties of emerald. The clear sky-blue and sea-green varieties are known as *Aqua-marine.*

The beautiful green colour of the emerald is unsurpassed by any other jewel. The crystals of these gems are hexagonal. The cleavage is imperfectly basal. The lustre is vitreous, and rarely resinous.

These stones are extremely brittle, and the emerald is

so soft, when first withdrawn from the mine, as to crumble by friction; but it hardens on exposure to the air. The chemical composition is—

Silica . . .	68.50
Alumina . . .	15.75
Glucina . . .	12.50
Peroxide of Iron .	1.00
Lime . . .	0.25
Oxide of Chrome .	0.30
Magnesia, Lime, and Soda .	traces.

Lewy gives it, as his opinion, that the beautiful green colour of the gem is attributable to the presence of an organic substance, similar to chlorophylle, which is the colouring matter of plants, and supposes the emerald to have been produced in nature by aqueous precipitation, rather than from gaseous exhalations.

In New Granada, where the finest specimens are found, the rock matrix is a limestone with abundant fossils. Such being the case, it is probable that the colouring matter may have been derived from the decomposition of organic substances, the remains of which are still to be seen.

There can be no doubt but that this gem was known at a very early period. Necklaces, etc., of emeralds have been found at Herculaneum. Nero is said to have used an emerald lens, through which to observe the feats of the gladiators; and ancient emerald mines have been discovered in Egypt. When the Spaniards conquered Peru, they found immense hoards of emeralds in the temples.

The emerald is so rarely found perfect, that the saying, "an emerald without a flaw," has become a proverb.

Euclase is a silicate of alumina and glucina. It is harder than quartz, but very brittle. Usually it is colourless, transparent, and lustrous. Its chief interest is its extreme rarity.

v. *Felspar*, etc. A great variety of silicates of alumina, with different proportions of potash, soda, lime, etc., in combination, come under this denomination.

Labradorite, *Sunstone*, *Moonstone*, *Obsidian*, are all felspathic gems.

III.—Magnesium and Silicon Group.

Chrysolite, *Peridot or Olivine*.—This gem is composed of silicate of magnesia, with iron, alumina, etc., and occurs in many volcanic rocks. It belongs to the monometric system of crystallisation; and is the softest of all gems. The Peridot is the dark green variety. The Chrysolite is the greenish-yellow sort. It may be called the 'stone of affection' of the late Sir David Brewster, being so celebrated in his optical experiments.

The Peridot is the only gem that has been found in aërolites. Its optical properties render it of great interest to the Mineralogical Optician. Haüy possessed a minute crystal which had a peculiar property, and, though of no value as a jewel, he is said to have prized it more than he would a large diamond. Ceylon, which is above all other places celebrated for its abundance of gems, furnishes no specimens of peridot.

IV.—Zirconium and Silicon Group.

Hyacinth, *Zircon*, or *Jacinth*.—This gem belongs to the dimetric system of crystallisation. It is not so hard as topaz, and varies in colour and transparency. When heated, it becomes phosphorescent, and loses its colour. The phosphorescence does not occur in specimens which have been allowed to cool after being heated.

It is unassailable by acids, and melts with borax. Its chemical composition is —

Zirconia . . .	66.8.
Silica . . .	33.2.
Peroxide of Iron .	0.1.

The Zircon, or Hyacinth, occurs in granite, syenite and gneiss formations, and in detritus of that nature in river beds, etc. It has been found in the lavas of Vesuvius.

When this gem is of a greyish colour, it is called *Jargoon*, and such specimens have 'jargonia' as an element of their composition. The jargoon resembles the diamond most nearly in its lustre, and has often been mistaken for it. In the last century it was much worn.

This gem possesses double refraction to a high degree, and does not acquire electricity by heat.

V.—Aluminium and Silicon Group.

Topaz is a silicate of alumina with fluorine, crystallising in prisms. Colour — white, red, yellow, blue, or green. It is lustrous, transparent, and harder than quartz. The Oriental Topaz is a Corrundum. The yellow topaz assumes a pinkish hue when subjected to heat, and is then called the 'Brazilian Ruby.'

Topaz is widely distributed in granitic strata.

The topaz belongs to the tri-metric system of crystallisation. Its cleavage is basal. Specific gravity, 3.5 or 3.6.

The chemical analyses of Brazilian topaz and Saxon topaz, are:—

BRAZILIAN.

Silica . . .	34.01.
Alumina . . .	58.38.
Fluorine . .	15.56.

SAXON.

Silica . . .	34.24.
Alumina . . .	57.45.
Fluorine . . .	14.99.

M. St. Clair Deville has detected Vanadium in the Brazilian topaz, and has produced the topaz by the process of precipitation from solutions.

The beautiful pink hue that we sometimes see in jewel-

lery, is never the natural colour of a topaz, but is artificially produced by heat upon the brown coloured specimens. The yellow topaz becomes white under the process.

The property of positive electricity is highly developed by friction, and this alone affords a simple and satisfactory test.

Tourmaline is a variable mineral, composed of silicate of alumina, with boracic acid, and a varying proportion of magnesia, iron, manganese, or lithia. It crystallises in prisms; and is usually black. It is also found of a brown, blue, green, or red tint, and is sometimes colourless. It may be either opaque, or of any degree of transparency. It is harder than quartz.

Rubellite, or red tourmaline, is a precious gem, if of good colour and clear lustre.

Tourmaline is common to granitic rocks in many countries. It belongs to the rhombohedral or hexagonal system of crystallisation. The specific gravity is 2.99 to 3.33. The lustre is vitreous.

Its refraction is double, and exhibits dichroism. Its property of polarisation is so great, that it is extensively used in the construction of polariscopes, for testing the optical properties of other minerals.

VI.—Sodium and Silicon Group.

Lapis lazuli is a beautiful example. It is a silicate of soda, lime, and alumina, with sulphur. Sulphide of iron, or iron pyrites, is disseminated in minute spangles throughout, looking like specks of gold on a blue ground.

VII.—Aluminium and Magnesium Group.

Spinel.—Under this head must be classed spinel ruby, rubicelle, balas ruby, and almandine ruby, being all of them but varieties of the same gem. There is also a black variety, called *pleonast* or *ceylonite*. The *chloro-spinel*, the *sapphrine*, etc., are also coloured varieties of spinel.

The spinel is found embedded in granular limestone, and in calcareous spar; also in metamorphic detritus, etc., in many countries. It belongs to the mono-metric or cubic system, and is usually found in octahedrons. The lustre is vitreous, and it is harder than quartz.

The chemical composition of red-spinel from Ceylon, is—

Alumina . . .	69.01.
Magnesia . .	26.21.
Protoxide of Iron .	0.71.
Oxide of Chrome .	1.10.
Silica . . .	2.02.

The original of the term "balas," or "balais," is the ancient name of Beloochistan, Badakschan, or Balaschan.

Marco Polo speaks of these stones being found in the mountains called Shekinim.

VIII.—*Chrysoberyl* and *Cymophane* are a compound of *alumina* and *glucina,* with some oxides of iron and other metals. The variety that has a bluish white opalesence is called *cymophane.*

Chrysoberyl is a very brilliant gem, of a yellow, greenish-yellow, or brownish-yellow colour, and occasionally white.

It belongs to the tri-metric or rhombic system of crystallisation, and possesses a vitreous lustre. Its cleavage is imperfect. Specific gravity 3.680 to 3.754. It is harder than quartz. It possesses double refraction to a high degree, and becomes positively electric by friction.

The "cat's eyes" of commerce are really *cymophane,* which is the semi-transparent chrysoberyl.

The name chrysoberyl is derived from *χρυσὸς* (golden), Βήρυλλος (beryl), and cymophane, from *κύμα* (wave), and *φαίνω* (appear), in allusion to its variable colour.

IX.—*Copper.*—Green carbonate of copper, deposited by water as a stalagmite, produces *Malachite.* The finest specimens are found in Siberia, Australia, and Africa.

X.—*Iron* in combination with sulphur, crystallising in various forms, furnishes *Marcasite*, *Pyrites*, which are scarcely considered to be gems now; though they were much esteemed in the 17th century.

VII.—Conclusion.

The length my paper has attained to excludes any further observations on the artificial production of gems, the colours of the natural jewels, their crystallography, and optical peculiarities, all of which offer a wide and interesting field for research. Nature has yet innumerable secrets, which she tenaciously holds, and great as the progress of discovery in the regions of physical science has been during recent years, we still look forward expectantly to future conquests in this field of knowledge; while at present we contemplate with intense admiration, these beautiful "flowers of the mineral kingdom,"—the most marvellous evidence of the transforming energy that Nature exercises in the processes of her unrivalled laboratory,—an energy surpassing in its effects that which was sought for by the Alchemists in the "philosopher's stone," for, while that was to convert stones into gold, Nature's magic power transforms such common materials as carbon and clay into the peerless diamond and the rich and lustrous ruby.

ON THE SCENIC EFFECTS PRODUCED BY WATER.

By THOMAS INMAN, M.D. Lond.

At the moment when this essay is begun, I am sitting in a room in Zermatt. On my right front towers the huge Matterhorn, and on the left front lies the end of the Gorner glacier, covered, to a great extent, with dirty débris, which consists of stones of various sizes, all more or less angular. As I view the former, my mind reverts to the statement made by Whymper and Tyndall, that a rain of stones is almost constantly falling down one face of Mont Cervin; and, as I look at the latter, I see that in its course it has passed in the vicinity of precipices, from whose face many a rock-fall has taken place. One such, indeed, I can see in operation. It is clear, then, that the mountains in sight are being diminished in bulk and height; and, when I look at the brawling river, white with pounded rock, and bearing down many large stones, it is evident that the substance of the mountains goes to fill up valleys, in the first place, and seas, in the second.

From the glacier of the mountains pours a turbid stream, like milk, bearing with it an infinite quantity of stuff, which it deposits as coarse sand, wherever the furious current has its force abated, by passing over a large area, or slowly through wide pools. The actual amount of detritus contained in the Visp, and in the Rhone, would, if it were collected, suffice to make a fertile meadow, of about ten acres, every four-and-twenty hours.

By the side of the Matterhorn, there are other mountains, of lower altitude. Beyond it, but out of my range of

vision, is Monte Rosa, whose summit is higher than that of Mont Cervin. When I ask myself what raised these mighty masses, and contemplate what I have already observed elsewhere, I turn with complacency to my guide-book, and read the following remarks, quoted by Bædeker, from Bernh. Studer: "De Saussure deemed it impossible to believe that the sharp pyramid of the Matterhorn could ever have been upheaved from beneath; the sharpness of its edges, its pillar-like form, and the regularity of its stratifications, all contradict such a supposition. How could a force, acting from below, whose effects are seen in raising the level of whole districts, effect the uplifting of such a sharply defined mass from the level around? It is, however, a geological fact, as astonishing as true, that the whole of the surrounding district has been raised from its former level, by a force acting from beneath. This widely extended convulsion elevated the entire surface to an uniform height, but, after the disturbing causes had subsided, the more loosely stratified portions gradually sank [for this, I believe, we should read, 'became disintegrated, and washed away'], leaving the gigantic, pillar-like masses of Monte Rosa, the Lyskamm, the Matterhorn, the Dent Blanche, etc., standing erect amidst the débris." What does this, when reduced to plain language, involve? Simply this, that a mass of mountain, whose original height was probably fifteen thousand feet above the sea, has diminished in altitude, until it is about thirteen thousand feet, and this by the gradual breaking down of the solid rock into small and easily detached fragments, which have long since been dissolved by rain, crumbled to powder by air, frost, and sunshine, or swept bodily away by some ancient glacier. It is impossible for a thoughtful mind to pass these ideas in review, without inquiring, What has really become of the material, which has apparently been wasted, and what are the agencies that have been most

powerful in producing the metamorphosis? I propose to investigate these questions in the order wherein they are propounded.

In answering the first query, let me, in imagination, conduct my hearers to the vast plains of Vienna, and of Munich, made up mainly of alluvium, and the more limited champagne of Salzburg. When we dig under the surface of these two last parts, we find the land resembling that made by torrents at the foot of mountains. The material consists of water-worn stones, whose character is identical with mountains that exist at a higher level. To what an extent this deposit is found, may be judged from a few facts, which I only propound as approximately true. The plain upon which Munich stands has an area of about two thousand five hundred square miles, and whenever deep excavations have been made the thickness of the gravel referred to has been found to be six hundred feet. Below this, blue clay is discovered. The plain around Vienna is equally extensive, and the deposit composing it is such as may be termed "lacustrine." In the town of Salzburg, there are three or four conspicuous hills, or mounds, about three hundred feet high. These stand, like advanced posts, before the higher mountain ranges; beyond them is a level plain. Each of the lesser mounts consists of a nucleus of limestone, which only appears at the highest points. At a lower level, this is completely covered by a hard breccia, or conglomerate, which rises to a height of about seventy feet above the river. The stones composing this rock are all rounded, and have evidently first been deposited in a lake, or river, and then consolidated by the action of lime. The low hills have been islands in this sheet of water. I could not discover the depth of the breccia. My hearers will, probably, here inquire how the lake which I have presumed to have once existed became drained? The reply will be given shortly.

But there are still other illustrations of which the traveller is bound to take notice. When he takes the railway from Verona to Milan, he passes through fields whose understratum is made up of large or small water-worn stones; and, when he regards the vast plains of Lombardy, he discovers that they are composed of alluvium, like the delta of the Nile, the Mississippi, or the Euphrates. If he passes by rail from Venice to Trieste, he travels over a gentle slope, more than fifty miles in breadth, and can see, in various cuttings, that near the former city there is little but fine mud, but, when he nears the mountain, he notices that the deposit becomes gravelly, the stones being always rounded, or flat, as if they had been in a stream, and deposited therefrom as inundations subsided. Nearer the hills, the boulders become larger, and at length the traveller reaches low mounds, the remains of what once were probably tremendous hills. Going northward, towards the Brenner, he will find that the altitude of the mountains increases, and thence infer the probability that the central masses of rock were covered with ice when the out-liers were subjected to torrents of rain.

A still more remarkable example of the effects of wear, and a particularly good specimen of the enormous extent of the transportation of débris, is to be found in the Rigi, and some other of the neighbouring hills. This popular mountain, which is nearly six thousand feet in height, is entirely made up with conglomerates, and it, with its allies, covers about three hundred square miles. As a large portion of the Rigi and other mountains of the same kind have gradually been washed away, we may conclude that we only now see a very small portion of the original deposit. Again, when the traveller leaves the Bernese Oberland, for the low-lying plain extending between the Swiss mountains and the Jura range, from Zurich, on the N.E., to Geneva, on the S.W., he will find, in railway cuttings and other sections, that

the soil is all made up of recent formations, the detritus of older rocks. There can, then, be no reasonable doubt, that enormous masses of what once was mountain have been conveyed from their original position, and deposited, most probably, in still water, or at the foot of mountains, in sluggish streams.

Let us now stop for awhile, and inquire, what is the difference between a deposit of detritus in a lake or sea, and on the comparatively dry bottom of a rocky valley. If we turn to the huge < shaped mounds that are to be found in almost every valley in mountain regions, and look at the stones composing them, we find, as a general rule, that they are angular. Bits of rock, chipped off, and at once carried down by water, have not time to be rounded by rubbing against each other; for, as each successive batch of fragments descends, the old ones are covered up, and sheltered from the influence of the air and the motive power of water. When, on the other hand, the stones fall into a stream and are carried forward with it until it reaches a wide part, or develops into a lake, the pebbles are worn by constant friction, and made flat, or spherical, or oval. They are also deposited in layers of variable material—mud, sand, fine and coarse gravel, according to the amount of rainfall, and the consequent velocity and volume of the river.

In the Tyrol, I have seen many lakes, which have received such large quantities of these stones as to have become all but plains. The most interesting, because the most readily understood, is at Spondini, on the Tyrolean side of the Stelvio Pass. From that spot, up to Innspruck, many such lakes may be seen in every stage. At Imst, the observer will recognise a plain which has once been a lake, and he will also readily see how slowly the level of the water has subsided. Leaving, for the time, the question

how lakes are originally formed, let me attempt to explain how this particular sheet of water has been drained. It is almost a truism to say that, as soon as a basin receiving a river is full, it must overflow; the stream always finding the lowest part of the margin. It will readily be understood, that, if the margin always remains the same, the lake will not be drained; whereas, if the rocks over which the river passes are readily worn away, then a passage will be opened, by which the accumulated waters are discharged. In the lake at Imst, there were at one time two outlets, an island being between them; but both channels had not the same style of rock. One was sooner disintegrated, or worn away, than the other, and, as a result, what was once a stream is now a meadow, from out of which pass a shallow, fertile valley, and a deep, rocky river-bed. A lake may be, and certainly often is, converted into a plain, by the continued deposition of detritus.

When we inquire into the agents at work, in transporting the vast accumulation of gravel that we have described as existing around Munich and Salzburg, we find two—one ice, the other water. I see, on the glacier before me, a large quantity of stones, great and small, which as the ice melts fall to the ground, and make the mounds, which are called terminal and lateral moraines. The blocks may come from a great distance, but, whether they have travelled far or not, they lie where the glacier leaves them, unless they fall into the torrent which emerges from every icy stream. We cannot, therefore, believe that ice has done much in producing such deposits as those of the plains of Munich, where all the stones are of comparatively small size, and water-worn.

On the other hand, the transporting power of water is everywhere visible in mountainous regions, and it is only bounded by the depth of a stream, and the inclination of its

bed. When a stream is rapid, it sends stones along with the greatest ease; and one may judge of the strength of former currents by the nature of the deposit which they have made. Water operates by its weight, as well as by its volume, and a deep and narrow current has more transporting power than the same volume in a broader bed.

As a good illustration of what I mean, a landslip may be mentioned, which occurred in 1807, in the Valley of the Adda, near Tirano, on the south side of the Stelvio Pass. The fall of rock was so sudden, and its amount so great, that it formed a regular dam across the valley, and a lake was formed on the higher side. The water accumulated during eleven days, and then was deep enough to sweep the dam, and the river banks beyond it, away. The breaking of the Holmfirth dam, and that at Bradfield, near Sheffield, had a similar cause and effect.

It does not, however, require much evidence to prove the transporting action of water, to those who travel in mountainous regions. Two days before I began this essay, I walked up a road from S. Nicholas, to Zermatt. As a rule, the highway passes along the edge of the stream called Visp, an impetuous glacier river, which runs between two precipitous mountain cliffs. On the opposite side to the road, the rocks generally are not much weathered, but on the same side as the road they have crumbled down to such an extent, as to make a distance between the river and the mountain of about a thousand yards. In the short distance of eight miles, the road has been rendered temporarily impassable to carriages in four places. A river, now quite dry, has come from a mountain ravine, bringing with it such a mass of stone as to cover the old road to a depth of ten feet. The boulders brought down vary in size, from a small marble to the largest beer-barrel made, and they cover a space at the river side varying from one hundred to a thou-

sand yards across. Doubtless, a large quantity has been carried into the stream, and by it swept away.

We next approach the interesting question, whether a stream which is frequently receiving rock-falls, and other detritus, really becomes deeper or shallower. The answer is easy, viz., that when the current is deep and strong, the river bed falls, instead of rises, being worn down by the grinding of the stones upon the bottom and each other. In Pfeffer's Gorge, I have seen some very large stones water-worn, and some granite boulders, reduced in size, near the Morterasch glacier, Pontresina, and their upper surfaces now far above the stream, even when in flood. But, when the current abates, the débris collects. For example, at Vispach, or Viege, the people have been obliged to raise a wall, to prevent the river inundating the town during floods. The bottom of almost every mountain stream in Italy rises when it crosses over the plains. The bed of the Po is much higher (25 feet) than it was eight hundred years ago. The bed of the Tiber has probably equally risen.

I now approach another part of my subject, which will, I hope, interest others as much as it gave me pleasure. When slowly toiling up Monte Pellegrino, by Palermo, on a sweltering hot day, my attention was drawn to an innumerable host of blocks of limestone, which strewed the surface of the ground. These had not fallen, apparently, for there was no higher level from which they might have come. They seemed, rather, to be hard bits of rocks, which had not been worn down like the general mass had been. Every one was marked in essentially the same way, and I had some difficulty in selecting a typical crag. I found one, at last. Without adverting to the strange round holes, made by colonies of some form of snails, and otherwise, I may say that the block in question was about five feet high, by six feet broad. This lump of limestone was seamed down its

side by valleys, melted away by rain which had fallen during centuries, and fairly worn away, or dissolved the limestone. Some of these valleys converged, and poured their water into a lake. There were two such lakes, each as large and deep as a cheese-plate. Each had a circumambient groove, thus—  where the water-waves had dissolved away the limestone from the lake. A miniature river also flowed down, forming a cataract. We looked at this lump, and then at the distant mountains. The big block entirely resembled the little one. This bit of limestone was so typical, that I desired a photograph of it, but the price asked was prohibitory—five pounds for the negative, and twenty shillings a copy. Since then, I have seen many such calcareous blocks, grooved in various ways, but not one more striking.

The ground about Palermo is of itself a study. There are some four or five high limestone hills. At the foot of these is a plain, and, wherever there is a section, or an exposure of the nature of the soil, one finds it to be a conglomerate of limestone débris. From a study of the block referred to,—and all the others told the same lesson,—it is clear that calcareous rocks are worn by rain, or other water; that they are worn irregularly; that they may be worn into valleys and into lakes; that the water, dissolving the lime, flows away, and reaches the valley, where it cements broken fragments together; that water wears away limestone mountains, as it does smaller blocks. In the bit of rock in question, were some narrow grooves, gorges, or ravines. It is probable, however, that the mountains around Palermo have been worn down by the action of the sea, plus rain, etc. Since visiting Sicily, I have studied the surface of ice and snow, and find that both are worn away irregularly, by sun, air, and rain, being thrown into hills and valleys, mountains and ravines.

This is peculiarly noticeable upon broad, and comparatively flat glaciers, where one constantly sees streams of water seaming the surface, and at last losing themselves in curious corkskrew-like apertures, which convey the fluid to the rocky bed, down which the ice-stream slowly moves.

The question now arises, Whether water acts simply as a solvent upon limestone, or if it acts in any other way? Let us inquire into it. In days gone by, at a "gallery" in London, a disc of soft iron was made to revolve with extraordinary rapidity round its centre; and the curiosity of this exhibition was, that this soft iron cut through files with the greatest ease. Again, in the church of St. Peter, at Rome, very nearly a third part of the toes of a bronze statue have been worn away by the Faithful kissing the foot. Here, there is not any solution of the metal, but simply a mechanical carrying away of an infinitesimal quantity at every touch. As far as I can remember, without books, there is nothing in granite, gneiss, slate and mica, or talcose schists, that water will readily dissolve. Yet water wears grooves in all these, as distinctly as it does in limestone.

If we attribute the wearing action of water to its friction, one has some idea of the vast extent of time requisite to form such gorges as the Via Mala, Pfeffers, and the like.

I must now call my hearers' attention to the fact, that some water-worn gorges do not undergo any material change, whilst others vary in shape very rapidly. Amongst the first, we may classify the wonderful gorge of the Zambesi, described by Livingstone; the ravines in Colorado country, some four thousand feet deep, with their sides unchanged, and extending many hundreds, if not thousands, of miles in length. There are similar gorges in many parts of Switzerland, amongst which we may enumerate one at the Rosenlaui glacier; another, close to Pfeffersbad; another, called the Gorge de Trient, in the Rhone Valley, at Vernayez; and

another at Tourtmagne, in the same locality. The last but one may be thus described, in the words of the guide book: "The view at the entrance of the gorge is very imposing. The rocks, here about four hundred and twenty feet high, approach so closely to each other at every turn, that the traveller continually expects to find himself in a mighty vaulted cavern. The sunshine never penetrates into this gully." The gorge is nine miles long, and the stream forty feet deep. In many parts of the *Via Mala* of the Splugen, there is a very narrow gorge, for about three hundred feet above the Rhine. At a higher level, the valley is much more open. Being desirous of ascertaining how it came to pass, that at the north entrance of the Splugen we should see a perpendicular wall of rock, and on the other a shelving slope, I began to make observations, with the endeavour to ascertain the cause.

The most natural solution seemed to be, that the rocks on opposite sides of a valley are really of different characters. This might occur by accident, but, speaking generally, they are as completely identical as a piece of wood into which I make a groove with a saw. If, then, we have to seek for another cause, let us endeavour to test, whether one side receives more rain, snow, or sun, than the other. In some of the valleys which I have visited, the rock-falls have been almost exclusively on the south side; in others, they have been on the north. In fine, a prolonged inquiry shows that the aspect, as regards the points of the compass, has little or nothing to do with the disintegration. Nay, it often happens, that at one part of a valley the north side is the most worn, whilst at another the south side is the most friable. At the period when I was investigating the point, I made a second journey to the gorge of Pfeffers. From Ragatz, the traveller directs his course up the bank of the impetuous Tamina, and on entering finds upon one side a

towering precipice some eight hundred feet in sheer height, whilst on the other there is a shelving bank of a similar altitude. As we progress, both banks become more shelving, and we see vast quantities of débris. At length we reach the Baths, pay a franc, and then, by means of a wooden gallery, enter upon a cavern some three hundred feet deep, and about forty wide. It is somewhat open at the top, and here and there a stray sunbeam can enter, but generally it is gloomy, and nearly dark. At the bottom, flows the Tamina, and on its sides, far above its level, we see everywhere the well-known grooves, curves, etc., produced by the action of flowing water. The rocks are composed of black limestone, or crystalline slate, with here and there strata of quartz and shales. The material is very hard, and the time required for wearing it away has been enormous. In the cavern, the water-marks are perfect, from the surface of the stream to the summit; but no sooner does the observer emerge once more into daylight, than he sees that the water-worn appearance almost abruptly terminates. In those parts to which the sun has not access, some grooves may still be found; a few are partially lost by disintegration; the majority that have existed can only be recognised by coarse rough curves, and their position by the side of the torrent. Bending our steps again towards Ragatz, we look along the river banks, to see if the stream is still wearing down its bed. I could only discover one spot which I would like to point out to a student; but that one is eminently interesting. A huge block of black rock has here fallen into the river, and partially obstructed its course; but, nevertheless, the stream runs on each side of it, and is grooving its flanks deeply. But by far the most important thing is, that its top, now about ten feet above the stream,—which was in flood when I visited the place,—was deeply cut by the old Tamina, which is ceaselessly cutting its way

deeper into the bottom of the valley. Close beside this rock, and on the mainland, I counted a dozen distinct water-marks above the stream's level; but, of those, four were considerably disintegrated. It seems clear, then, that the action of water in the formation of valleys has been almost ignored, in consequence of the rapidity with which the marks that it leaves are destroyed by atmospheric and other causes.

When the traveller understands this subject clearly, it gives great additional pleasure to his wanderings, for problems are constantly occurring which require solution. Of these, there is a good example close by Glarus, in the valley called Klein, or Klon, Thal. There one sees, between the massive Glärnish on one side, and the Wiggis on the other, a huge dam, which seems to block the valley up. We may compare this to the transverse bar in the letter A. As we drive upwards, we see that the rock of which this is composed is excessively hard, and very little friable. It extends some three or four miles up the valley, and is only worn in one place, where a river has ground a groove into it — a narrow channel, some three hundred feet deep, and barely ten feet wide. Lower down the valley, below the town, we see isolated mounds, not unlike the Tynwald hill in Mona. These are fragments of the same kind of hard rock which have resisted disintegration more firmly than their neighbours. These, and the dam in question, are, I think, basaltic or volcanic.

It is difficult to understand how it happens, that mountains, made up of the same materials, should wear away differently in different parts, but there is no doubt that they do so. In this, they only resemble ice and snow. In this point of view, an iceberg is not very dissimilar to an Alp. The most common form assumed by the hardest parts of limestone rock is that of a basin, with about a sixth part of

its side knocked out, the rest being everywhere more or less cracked, from top to bottom. We may often see these imperfect cauldrons standing on a high mass of mountains, just as a punch-bowl stands high above a table. I understand that their technical name is "cwms."

The next point of interest as regards these valleys is, that many have been, and still are, occupied by glaciers; but the rain and weather preceded the ice,—for a glacier ever follows the course of a hollow, it does not make one,—the great ice-stream does not rend rocks asunder, it only polishes and grooves them. It is, to be sure, a carrier of blocks, that rain, sun, snow, frost, or other influences detach from the mountain sides; but even here its agency is passive, and not active.

It will be convenient now if I refer to some very remarkable phenomena, to be seen occasionally upon mountain sides, near the bottom of valleys. There are three or four such near Botzen, in the Dolomite country — notably at a spot called Lengmoos; some also may be seen in the Visp valley, about opposite to Stelden. These are pyramids, and look not unlike a hock bottle having a large stopper on the top of the neck. Generally there is one piece of stone at the summit, and below is a lot of hard mud gradually worn away by rain, leaving, however, that which is protected by the stone from the effect of the water. Some of these are sixty feet high or more. It is not necessary that there shall be a bit of rock at the summit, for I have seen many which are simply cones, and very symmetrically arranged.

Lyell, in his elements of geology, refers to these pyramids, and fully explains their formation. They are due to rain operating upon the detritus left by the melting of an ancient glacier. Similar phenomena are to be found wherever there have been rivers of ice. We see the same kind of pyramid in the valley leading from above Botzen

to Bishopshofen; and again in the Vispthal. We do not, however, see these pyramids in England, where there is certainly a large amount of glacial débris. On the Cheshire side of the Mersey, for example, between Seacombe and Liscard, there are clay cliffs precisely resembling in the character of their material, those at Langmoos. Similar, but higher cliffs, are seen between Blackpool and Bispham—but we very rarely, if indeed we ever, see anything amongst them approaching to a pyramid.

This is due most probably to the fact that the upper surface is protected by vegetation, which prevents the rain disintegrating the surface, and to the fact that the downfall in England is not so heavy as that in hotter countries. The influence of vegetation in conserving the integrity of the soil on which it grows has long been recognised. It operates mainly by tying together, by frequent interlacements, the innumerable superficial particles of soil, so that none, however small, can be carried away by streams of rain; and by its opposing an elastic cushion to the falling water it takes away the force of each heavy drop, which, as we may observe in uncovered sand or mud, is sufficient to produce a considerable pit.

There is little doubt that the glacial epoch in Europe was preceded, as well as followed, by a period of great heat, during which the rainfall far exceeded that which it is now. From their nature, glaciers only flow down valleys, and these, consequently, must have been formed ere they received the icy stream. Then, again, this heat has been followed by a cool period, in which mountains once exposed freely to the influence of rain and frost, and worn down into peaks and passes, have been covered with a very thick coating of preserving snow.

Of the enormous amount of denudation which has taken place during the hot epochs, visitors to Chamounix can

see a wonderful example. Mont Blanc has once been part of an elevated table land. Originally formed at the bottom of a primeval sea, it has in some way been elevated to a height of probably fifteen thousand feet or more. Then being exposed to the influence of rain, frost, and heat alternately, the vast mass has been seamed by innumerable rivulets, which have deepened into gorges or broad valleys, until far more than half of the original has been worn away; those parts only being left which have been the least porous or the most hard. These now appear to the tourist as needle- or spire-shaped pinnacles of rock, which, like those left by the miners of the Llandegai slate quarries, tell of the height of the rock around ere yet it was worn away. Then after this mighty denudation, the whole, or at least every part upon which snow could lie, has been coated with crystallised water, which, uniting into ice, has flowed down for ages along the valleys made by preceding rains. Once again has come a hotter time, when a tropical climate and rains have melted the accumulated snow and ice, and brought down mighty torrents, which have swept bare the valleys through which they flowed. Once more the climate has become cool, and the mountains to a certain degree covered as we see them now.

Of the vast duration of time required to bring about these changes, it is difficult to form an idea.

Without entering into any well known calculations, let me mention one which I made after visiting the well known cave at Adelsberg. Since a re-discovery of a part of it, some fourteen years ago, a company of gentlemen have paid very close attention to a particular stalagmite upon which a drop of water perpetually falls. Since then, there has been formed on its summit a coating of lime as thick as the thinnest Indian writing paper. Starting from this basis, I found that the largest stalagmite, which is sixty feet high,

would require for its formation four million years. This is a wonderful period truly, but it has to be increased when we consider that the limestone strata from which the stalagmites come must have existed long before.

It has been stated that some stalagmites increase in height much more rapidly than others, but I have not been able to find any evidence of the truth of the assertion, nor of any other individual stalagmite having been the subject of observation.

The testimony of the rocks then carries us back to a time of which the human mind cannot form an adequate idea; and even if we strive to grasp it, we find that we are only on the threshold of another inquiry which carries us into immensity. For example, on the north side of Lake Wallenstadt are a series of mountains, which in reality are nothing more than a vast mass of sedimentary rock, which has been upheaved from the depths of an ocean, and then seamed by rains until an enormous portion has been carried away, leaving the rest in the form of towering precipices and craggy peaks. These summits, which pass by various names, vary in height from seven thousand to about eight thousand feet above the sea; about six thousand above the lake. Than these there are no higher mountains near. Going northwards, the country is comparatively flat. But if one directs his steps southwards to Glarus, we find mountains of a similar composition, and even of a greater altitude. The Schilt is seven thousand five hundred, Wiggis and Glärnish are about the same; the Kärpfstock is nine thousand one hundred and eighty, and the Haustock ten thousand three hundred and fifty four feet. Now all of these consist of stratified sedimentary rock, containing marine fossils, and the strata are as distinct as the lines of brick in a house wall. If one goes further south, towards the Tödi group, whose highest point is about twelve thou-

sand feet high, we see the same formation, viz., sedimentary and stratified limestone or other rock. Than these there are no higher grounds nearer than the Bernese Oberland. The traveller finds the same kind of sedimentary rocks in the Austrian Tyrol. The lake of Halstadt lies in a deep basin, whose walls, from three to four thousand feet high, are composed of stratified and sedimentary limestone, with marine fossils therein; and so are the rocks around the lovely Königsee. That these strata have been deposited in a sea there can be little doubt, for not only are certain fossils discovered in them (full particulars of which I cannot give), but amongst them are found those vast deposits of rock salt from which the Austrian Emperor gains so large a revenue. These saline accumulations are associated with what *in situ* is apparently a dark grey mud, but which on exposure becomes a sort of slate.

In connection with the salt, but not within it, many marine fossils are discovered. At Bex also, in the valley of the Rhone, where sedimentary rocks similar to those already described are to be found, a large deposit of salt exists in connection with shale, slates and clay. Concluding then, as we are bound to do, that the stratified rocks have been deposited in a sea, and knowing that their thickness in perpendicular height equals at least about ten thousand feet,—and how much more we cannot even guess,—it follows that prior to their time there were high lands, probably granite, whose disintegration was instrumental in forming the new material.

Of the enormous height of these ancient mountains, and of the duration of time through which the process of disintegration has continued, some idea may be formed by a traveller between Pau and Eaux Bonnes. As soon almost as such an one has left the plain and entered the hilly country, he will find a section by the road side which

discovers sedimentary rock, consisting alternately of limestone and shales, that have by some convulsion been thrown into the perpendicular. The original depth of the deposit was, as far as I could judge, four or five miles, for circumstances prevented me from being precise. Of the area over which the various limestone and other deposits extend, I am wholly unable to speak exactly. They form the greatest portion of the Pyrenees, the Jura range of hills, and a great part of Switzerland and the Tyrol.

We see then that during a period when a large portion of Europe as it now is was under water, there was in some part or another an enormously high and large mountain mass, or many such, whose sides and summits were gradually worn down and carried away to a distant sea, in which they accumulated for countless years. Where, let us ask, are those mountains now? I doubt if we can form an idea. The bed of the Mediterranean is moderately level, so is that of the Atlantic. Must we look for explanation to the Himalayan range, and to the vast highlands of the Caucasian or other Asiatic hills, to account for the Alps and Apennines? Or may we entertain the idea, that the same power which upheaved a part of the ocean bed depressed at the same time, or at any other period, existing mountains, converting them into plains? One thing is certain, however, viz., that deposits of enormous thickness, and for whose accumulation countless ages have been required, were in the course of time raised above the sea level at least about twenty-thousand feet. For many of these mountains, after myriads of years of denudation, are thirteen to fourteen thousand feet high.

No sooner however did this elevation take place, than the mass itself began to be disintegrated, under terrestrial influences or aerial; and now we see here and there huge gaps in the rocks, one or two miles in depth and breadth, and it may be more than a hundred in length.

In the presence of facts and considerations such as these, can any reasonable being doubt about the enormous length of time that our world has been in existence, or fail to marvel at the gigantic scale on which nature works? Can any one contemplate the vastness of the scheme of creation, without having his thoughts elevated to a far higher standard than that which prevailed when the book of nature was closed to students by human and ecclesiastical authority, lest they should perchance discover thereby that certain volumes, containing the fancies of semi-civilised men, were without any true knowledge of the Mighty Master of the Universe.

When this essay was first penned, it was my intention to avoid every reference to systematic geology, and to everything partaking of the nature of controversy; for, in the first place, whilst I was travelling, there was no opportunity for me to refer to books upon the subject; in the second, I had never been able systematically to study geology as a science; and in the third, I was desirous not to overlay my travelling experiences with a thick layer of argumentative reasoning.

But after having shown to friends who are more versed in geology than I am the drawings and photographs of places upon which the preceding essay is mainly founded, I feel almost compelled to make some observations which may appear to be disputatious.

I find that Colonel George Greenwood, in a book entitled *Rain and Rivers*, has propounded a series of observations essentially similar to those which, probably after a long interval, I have herein advanced; and that he and other authors entertaining the same views have been opposed by many, who not only doubt the wearing action of water and aerial influences generally, but uphold the doctrine that the majority of the phenomena presented by inland mountains and valleys depend upon the erosive and other actions

of seas, lakes, and other vast bodies of water, like the lower Amazon, in which waves, tides, and currents form the chief power in effecting terrestrial change.

To enter fully into the merits of this controversy would be injudicious in me; I shall not therefore attempt to do more than allege, (1) that the observant traveller can judge readily between effects produced by agents now in operation on the spot, and those which were active in former years; (2) that he can readily distinguish between the influence of the waves and currents of seas, or great lakes, and of rivers and aerial operations,— including the action of heat, cold, ice, snow, and light; (3) that experiment and observation demonstrate — (*a*) that all stones or rocks, however hard they appear, are liable to be dissolved or worn away by rain water and rivers; (*b*) that in the same class of rocks there is great difference in the resistance to the erosive or abrading influence of aerial and aquatic agencies; (*c*) that under apparently identical circumstances a variety of results is obtained; for example, one may repeatedly notice at the summit of a high Alpine "pass" a mass of snow, which has been for months acted upon by sunshine and rain. Our first inference would be, supposing always that its depth is such as to preclude the operation of terrestrial influences, that all the surface would melt away evenly, except in those parts where the mass would be sheltered from sun or rain, and from the reflected heat of rocks. But no such thing is seen — the snow melts away irregularly, leaving hills, hollows, and lake-like pits. I have already pointed out that this is true of ice. Every berg seen upon the ocean proves that all its parts are not equally soluble. I show to the Society a fragment of black limestone, from one of the islets of Lough Erne. It is clearly composed of sedimentary matter, which has been deposited near some ancient sea margin, and most probably about extreme low

water mark. It contains within it the remains of "tubularia" and stone lilies, shells, and algæ. In the part unexposed to the influence of rain and the waves of the lake, the stone seems homogeneous; yet where the surface has been unprotected, the limestone has been dissolved away, leaving the organic remains almost untouched. In like manner the traveller constantly sees, on the summits or on the sides of mountains, large masses of rock which refuse to be worn away, and stand out from the neighbouring masses as towers, churches, castles, spires, lions' heads, or even like some giant man,—witness Mont Cervin and the Aiguilles at Chamounix. In India I have been told by scientific friends, that granite rocks are worn away by the constant fret of rivers, until deep gorges are cut into them, resembling the "canyons" that are so common in Colorado. In Switzerland, moreover, one sees at Pfeffers a hard metamorphic slate, abounding in veins of quartz, worn down just as we see limestone eroded by mountain streams.

No one who is familiar with stalactites and stalagmites need be told that the limestone rocks are pervious to water, and that this fluid in passing through them carries with it in solution, or suspended, a notable amount of material. Some of these formations I have dissolved in nitric acid, and have found in the residuum crystals of pure silica,—showing in the first place that some calcareous formations contain flint; and secondly, that even that hard substance is soluble in water: a fact which everybody who has visited, or read of the Geysers in Iceland, will readily allow; inasmuch as their mouths are surrounded by a layer of homogeneous silica, which has been gradually deposited from the boiling water of the steaming springs.

In order to ascertain the extent to which limestone is soluble, I placed under a water tap a fragment which I had long been carrying in my luggage. When the experi-

ment began, the weight of the stone, an irregular pyramid in form, was 650.5 grains. The water was regulated to fall upon it so as to represent a continuous heavy downpour of thunder rain; from time to time I abstracted the piece and weighed it; after having left it about two days in a fender to dry before a hot fire, and again giving it time to cool, it showed an increase in weight even after this desiccation. The flow of water was continued until the exposure had lasted a full month. The bit of rock was then dried during a week, and at the end of that time it was found to have lost just one-fifth of a grain, or in round numbers one two-thousandth part of its weight. Here the whole fragment was exposed to the influence of water, the ordinary fluid supplied from Rivington and our wells. To carry out the problem, we may say that, supposing the water had continued to flow over the limestone constantly at the same rate, the whole would have been dissolved in one hundred and eighty years. Had the fragment been a cube, and had the artificial rain only flowed over one facet, it is clear that a longer period would have been required to dissôlve the whole.

When once we visit carefully a limestone district which is wholly exposed to atmospheric influences, there are many phenomena to be noticed, which well deserve the philosopher's attention. (1) We observe that the surface of some forms is seamed by miniature rivers and rivulets, such as those which I have endeavoured to depict in my drawing of a limestone on Monte Pellegrino; * this is due entirely to rain, which finds out the softest spots. But I must for a moment linger over a phenomenon which I did not at first intend to notice specially, as it did not form any part of my subject, viz., that the block pourtrayed, as well as almost every other on the mountain side, together with the perpendicular cliffs of

* A drawing was shown at the Meeting.

the same mountains, were marked by groups of round holes of various sizes, which we found to be bored by ordinary looking snails — whom, so to speak, we caught in the fact. I am, however, bound to say that the limestone was also perforated by many holes much larger and more regular than those made by the molluscs. These I shall not at the present moment attempt to explain, reserving any remarks which I may have to make until I treat upon the probable formation of caverns.

In addition to the holes and depressions referred to, we constantly find in limestone what I may describe as "pockets," of various capacities The largest may for the present be left alone; the smaller contain what is known as fuller's earth, vegetable mould, humus, or other material which serves as soil. For example, on a hill close by Toulon, that consists apparently of limestone alone, enough of the red matter to which I refer has been collected to make a few terraces, on which vines, etc., are cultivated.

These pockets tell their own tale; their site has first been occupied by a variety of limestone, more soluble than that in the vicinity. This has been dissolved away, leaving a hole into which surface water has drained, containing "humus." Of this a large portion has been left, just as ordinary impurities pass not through a filter, if it is of great thickness.

But it may naturally be asked, How is it that impurities can pass at all, through what appears to be solid limestone? The best answer is, that they do so most unquestionably. I show you a specimen of stalagmite, reddened by a sort of clay. As the subject is worthy of a few words, I may refer to the phenomena witnessed in certain caves, viz., Kent's Hole, near Torquay, and the celebrated Adelsberg grotto. In the first there are two stalagmite floors; the first contains some earthy stuff, but

scarcely enough to colour it deeply; below this is a deep layer of red soil, resembling that on the surface of the country generally; and underneath this there is a second stalagmite layer, which contains a large amount of humus. It is certain that what is here called the second is much older than what is styled the first, and that when it was formed there was more material to be brought down from the limestone above than there was subsequently.

In the Adelsberg grotto there are stalagmites which resemble fat beef and bacon, so strong is the contrast between the clay or humus bearing stalagmite, and that which consists of almost pure crystalline carbonate of lime. One may fairly conceive that the dark layers represent very rainy seasons, and the lighter ones dry years or cycles.

The limestone district about Adelsberg is peculiarly fruitful in geological phenomena. Not only are there numerous caverns below ground, but there are on the surface a vast number of funnel or other shaped depressions, which indicate spots where the limestone has been unusually soluble. If any one of these depressions happened to be near a sea cliff, and a part was worn away, one would have the curious round or hemispherical hollow to which I understand the name of "Cwm" is given, and which is sometimes attributed wholly to marine influences. I do not like to advance anything of which I am not personally cognizant, but it may be pardoned me if I notice that Murray's *Guide Book* states that one of these funnel-shaped depressions has been found to be associated with a vast natural underground reservoir of water, or in other words a cavern, from which as yet there is no regular exit, and which receives a large amount of drainage.

If we assume for a moment that in the course of ages the superincumbent rock shall be dissolved away, the reservoir to which I refer will appear as a lake.

We may now therefore fairly inquire whether there are in that neighbourhood any lakes in existence now, or whether there were any in former times, which owe or owed their origin to the unusual solubility of a portion of rock.

The diagram which I show of a stone on Monte Pellegrino, distinctly marks two lakes, neither of them larger than a soup plate, but both perfect. Their margin, except at the exit of their water, is not only perpendicular, but overhanging. A section at any part resembling a note of interrogation ↳, the lower portion of the precipice! being worn away by tiny waves produced by innumerable drops of rain water on the "mere's" surface.

I connot conceive anything in a geological way more valuable than this stone, which, as I before remarked, was only one out of many. In the sketch given there is a distinct *cwm*, whose origin has unquestionably been exclusively pluvial. In passing, I may mention that I have seen repeated instances of water-worn limestone block grooved by water, but not one so curious and instructive as this, which roused me to make the observations which are imbedded in this essay. I ought to mention that, having been prevented from having the rock photographed, I had to make a drawing, and the diagram exhibited is made from the sketch by a lady of my party, who like myself was quite ignorant of geological discussions between subaerialists and mariners, *i. e.*, those who do not look to the sea to explain terrestrial phenomena, and those who regard the ocean as having left an indelible stamp of its own upon the land.

As in every, or nearly every, controversy, both the parties referred to are correct up to a certain point; and that point is one which may fairly be the subject of discussion. But no one, in my opinion, is in a position to argue upon the matter until his experience is varied as well as extensive. If Dr. Macintosh, for example, author of *The Scenery of*

England and Wales, had crossed over the Stelvio and the Bernina Passes, he would not have written as he has done respecting the origin of Cwms, or semicircular, sometimes almost circular, ranges of precipices, or, which amounts to the same thing, battledore shaped hollows.

My attention was especially directed to these curious phenomena between Bormio and Tirano, and again when I was near the summit of the Bernina Pass, on the south side.

In the latter position I could most distinctly see below me a valley conspicuously marked by ancient glacier action; whilst in the distance, and at a higher level, I could see horse-shoe shaped precipitous walls on a mountain side, which were nearly perpendicular inside and out. I grant, without a word, that the mountains which I looked at may have been at one time under the sea—for the sake of argument. But I assert that no amount of wave power would produce the phenomena which one could almost see growing under one's eye.

Let me for a moment transport my readers to Cornwall, and there point out to them the real influence of the sea and its waves. I will take them to every apparent cavern which I know, and show that the hollow does not depend upon the water exclusively, but upon what I understand that the geologists call "faults," *i. e.*, cracks in one form of rock, which have been filled by drift, detritus, or some other comparatively soft and easily abraded stuff. The water wears this away because it is readily converted into mud; when once the stuff is removed, the walls of the original crack remain in many instances angular, showing how small is the influence of the salt water.

In the preceding essay I have not made any reference to the abrading power of pure rain water in dissolving away breccia or conglomerate. The best illustration of this which I know is to be found in the vicinity of Nice. The land and

hills to the immediate west and north of that town consist of pudding-stone rock, of a depth probably of six hundred feet. Through this the rains of many years have worn deep valleys, some barely six feet wide. From these or into them pass or come lateral valleys. The whole may be compared to two letters E placed back to back, with an I above the junction and below it. Every one of the secondary gorges resembles the letter U placed thus ⊃; and so steep are the sides that I never found one which I could climb. Their walls are absolutely perpendicular; yet one finds scarcely any débris at the bottom; the whole of the interior of the ⊃ has been either dissolved or carried away. The wildest imagination could not conceive these lateral valleys, which run generally at right angles with the principal one, having been made by the sea, its waves or currents. My readers will now naturally remark that, if my observations are correct, it must follow that every year, to a certain extent, the mountains are becoming converted into plains. It undoubtedly is so; and no traveller can descend from the Alps or the Apennines without seeing that this is the case. The vast plains of Lombardy are composed of débris which rivers have brought from distant hill tops and mountain sides; and everywhere that which is called alluvium can be traced to similar distant sources. Without any farther upheaval every mountain chain would in time be worn away, those crags alone remaining which are sheltered by perpetual snow.

I may now extend my observations, and make a few remarks upon the formation of caves. As a rule, these are most common in limestone districts; but they are found in various other formations. Whenever they appear in the igneous or unstratified rocks, they always (in my opinion) represent a part where there has at one time been a fissure, which has ultimately been filled either with some form of

trap, or some débris which has less consistence than the original rock. This stuff is readily worn away, either by rains or the sea's action. In some cases, as in Fingal's Cave in Staffa, the hollow is probably due to the shrinking of a mass of molten basalt whilst cooling. In sedimentary rocks it seems to me that the formation of caves is due to one of two causes. (1) One finds in every limestone district large and small spaces, which are filled with earthy matters which refuse to be solidified, and which are readily converted into mud, and washed away either by rain or waves. For example, on Monte Pellegrino, near Palermo, there is, near the summit of the hill, a large cave, in which a poor mad woman dwelt whom piety converted into a saint, and to whom a grand church was built and dedicated. From the main chamber of the cavern proceed several small ones, in one of which the lunatic is said to have lived; most of these are hollow, but there is one which is partly filled with a whitish soil resembling fuller's earth; through this water constantly flows, bringing with it a notable quantity of this stuff; a process which in course of time will convert this storehouse into a cavern. Precisely the same kind of thing obtains at Biarritz, where I saw, at the end of a cavern in a precipitous cliff, a large hole, about ten feet high by six feet broad, in which was also a mass of whitish clay, which was being softened and carried away by the waves. Whether the deposit is coeval with the rock around, or whether it has found its way into a fissure, of course it is impossible to determine. It is, however, curious to observe that the material should remain soft, even although it is being constantly permeated by limewater. (2) It appears to me that, when vast thicknesses of limestone have been formed at the bottom of the sea, and there subjected to enormous pressure, and to complete saturation with water, and thereafter raised from any cause far above the sea, and subjected day after day

to solar heat, they are very liable to contract, and in the process to produce large rents or fissures. Or in the very act of rising their strata may be dislocated, so as to leave vast apertures. Assuming this for a moment, we can then see how such cracks may become subterranean water-courses, and either become enlarged by the erosive action of the underground streams, or become the depositary of mud, such as we find in the celebrated Peak Cavern in Derbyshire. If we were able to go with subterranean streams, as Sindbad is fabled to have done, we should doubtless find ourselves passing through many a vast cavern. The most remarkable cave into which a river flows is described in Atkinson's *Travels in Russia and Tartary*; there it is not known where the water emerges. But in the limestone district about Adelsberg, a stream, which enters a range at one part, is known to emerge in another, again to bury itself, and once more to come to light. When standing far above the entrance of the river flowing into the Adelsberg Cave, it seemed to me that the plain below me had once been a large lake, and that it had been dried up by the water suddenly finding a way through the limestone mountain which enclosed it.

Not far from this place there is a lake which has annually, or nearly so, been filled and emptied again since the time when the Romans first discovered it. Again, from the Königsee, near Saltzburg, flows an underground stream which emerges at Golling, seven miles away, falling in its course a distance of about seven hundred feet.

I need not add that when once caves are formed in limestone districts, they become partly receptacles for water and partly for the lime which the water flowing through the rocky roofs brings down and leaves. As it is clear that the cave must precede the stalactite and the stalagmite which it contains, observers can get an approximate idea of its age

by finding the depth of these formations, and ascertaining the rate at which they are formed. As a rule, all stalagmites must form with the same rapidity or slowness, the water from which they are produced being saturated with lime; but if one stalagmite is formed where there is a constant current of air, and another where there is perfect quiescence, the former will increase far faster than the second, inasmuch as air in motion increases evaporation from the water over which it passes.

Now, in Kent's Hole, near Torquay, two very thick stalagmitic floors have been formed, separated by an interval of about ten feet, which is filled by red earth and the remains of animals not now found in England, as well as the works of man and domestic creatures. Under these floors there may be many more, and they point to an antiquity of millions of years.

In one such cave at Menton, and at a depth of nearly twenty feet from the present surface, the skeleton of a man was found (see *Lancet* of Dec. 7, 1872), who had died calmly on the spot, and been tenderly buried by survivors.*

It now remains for me to make some observation upon the formation of lakes. In doing so I cannot hope to explain away every difficulty, nor can I propose to myself to do more than account for a certain number of phenomena.

Starting from my stone at Palermo, I assert that rock may be so irregularly worn away that miniature meres may be formed therein. In the fragment of which I show a sketch, there were two distinct depressions capable of containing water. In a small fragment of limestone, in which I made a hole by the action of hydrochloric acid not exceeding half an inch in diameter, there were three distinct depressions below the general lake bottom. It does not,

* A second skeleton has more recently been found, of which the particulars have not been published.

however, need such experiments to prove that rocks are worn away in varying rapidity, for every fly-fisher or traveller knows that every mountain burn or brawling brook has deep holes here and there, in which the finny tribe love to linger. I doubt whether any river is known in which there are not "deeps" and "shallows." Each of the former is to all intents a small lake.

Here let us for a moment pause, and inquire whether the pool is made by the superficial action of water, or upon its bottom being comparatively soluble, and being actually dissolved and carried away into the depths below it.

Leaving entirely out of the question the influence of winds, a subject which would take me far beyond the limits which I have prescribed to myself, I propound the assertion that lakes are formed, (1) by water dissolving away the surface, and carrying the solution through the rocky bed in which the hollow is made; and (2) by glacier moraines or landslips damming up ravines. I think that in Carniola and in the Tyrol one may trace some lakes which are or have been due entirely to the solution of large layers of limestone; whereas in Switzerland there are many which are due to an obstruction to the flow of water through a gorge. For example, I think from what I noticed that the Lake of Geneva was once a valley, only containing a river bed, but that it was converted into a lake by a huge glacier which came down from Chamounix, leaving where it melted a vast moraine behind it, which still serves for a dam. The lowest part of the lake bottom is about two hundred and fifty feet above the present sea level; and one can easily understand that the whole may be drained away by the gradual wearing away of the bed of the Rhone. But it is probable that the upper Rhone will convert Lake Leman into a plain before the water will wear a channel deep enough to drain away the mass of waters.

But there is one point to which I must advert, which was brought prominently under our notice a short time ago by one of our members, in his account of the Cheshire Salt District, viz., that lakes may be due to a subsidence of ground, owing to materials having been taken away or dissolved from a distance under ground. There can no denial be given; the fact is an established one, and it only influences the position which I have taken up by showing that the depression which forms a mere may be made by underground as well as by the superficial solution of material. The geologist, in each case brought under his notice, may investigate which is the most probable cause; but the general philosopher can well afford to pass such minor points by.

I may mention also, ere I close this essay, that Mr. D. T. Ansted, in a Paper in the *Cambridge Philosophical Transactions*, vol. XI., entitled, "On some Phenomena of the weathering of Rocks," calls attention specially to the influence of heat in producing cracks or fissures; of frost in producing disintegration; and of vegetation in producing rounded holes, and dislodging masses of rock. It is quite unnecessary for me to enter into these matters fully, as they belong more to geology proper than to the observations of an ordinary traveller. But I may borrow from him a concluding sentence, which so thoroughly accords with my own feelings, that I prefer copying to paraphrasing it. It runs thus: "If, therefore, we would learn how, when, and why the hills exist as we see them; how the valleys were scooped out; how the mountain crests became jagged; why the undulated surface of one country is developed into vast prairies, while the smoothed plains in certain districts become flat steppes and sandy deserts; why the plateaux are rent across with broad deep fissures; and why the

appearance of sea cliffs is simulated in the interior of a country by long lines of escarpment; we must observe existing nature before theorising on its past history, and steadily direct our view to that which is, before we attempt to explain the distant and obscure outline of that which was."

THE MERSEY AS KNOWN TO THE ROMANS.

By JOSEPH BOULT, F.R.I.B.A., &c.

It is upwards of fifty years since Dr. Ormerod, in his valuable *History of Cheshire,* adduced presumptive evidence that in ancient times the upland waters of the Mersey flowed into the Dee, on their way to the ocean. Since then, I believe, little has been done to confirm or disprove this conjecture, yet it might be supposed to be of considerable interest in this locality, and well worthy of attention from Geologists and Topographers. In the course of my inquiries into the changes in the bed of the Mersey, I have gleaned a few facts which may help to illustrate this important conjecture; and after briefly stating the views of Dr. Ormerod, and some other writers, I will submit my own conjectures as to the facts.

Dr. Ormerod writes: "The boundaries of the Hundred of Wirral on two sides are formed by the two estuaries; on the third side by the waters of the Irish Sea; and on the fourth, they are defined by a deep valley running across in an irregular direction from the Mersey, by Stoke, Croughton, Chorlton, Backford, and the two Mollingtons to the Dee, separating Wirral from the Hundred of Broxton."

The Doctor then remarks: "It will here be necessary to overstep the limits of the Hundred, and to observe that the raised terrace formed by Wirral, between the waters of the two estuaries, after being broken by the deep valley beforementioned, continues its course onwards, in a S. E. direction, towards the feet of the Broxton Hills, still retaining on its sides two deep and broad vales, each of which is a continuation of the line of the respective estuaries. The vale on the

N. E. is traversed during its whole length by the waters of the Gowy. The vale on the S. W. forms in its upper part the bed of the Dee, which, however, instead of proceeding down the rest of the vale to the estuary in a straight line, is diverted to the walls of Chester by a deep channel, formed in the elevated line before-mentioned, which carries the water past Chester in a direction nearly semi-circular, till it joins the estuary and the line of the great vale again, near Blacon point. This channel is supposed to be in a great measure artificial, and is stated in some antient pleadings relative to the Dee Mills to have been made by Hugh Lupus. *Harl. MSS.*, 2084, 157."

"That the waters, before the retiring of the sea from the western coast of Britain, occupied the line of these vales, will be doubted by no one who has looked down on the general level of the country, either from the forest hills, or from the ridge of the great natural terrace before-mentioned near Aldford or Churton. A tide, a very few yards higher than usual, would now cover them to a considerable extent. . . . .

"Having thus shown that vestiges exist, in the general face of the country, manifesting that the waters occupied a wider range than the present height of the tides allows, it remains to mention that a tide much lower than would suffice to cover these levels would fill the before-mentioned smaller valley which intervenes between Wirral and Broxton, and render the former Hundred a complete island,—as the country tradition still maintains it to have been at a distant period. The variation of level is indeed so inconsiderable that it was once proposed to take the Dee through this line into the Mersey, instead of pursuing its present artificial course by embankment; and it was in consequence of this suggestion that Mr. Pennant made a series of observations, which led to the connexion of the two rivers by the present canal." P. 187.

"At the point where this valley joins the Mersey, we have the township of Ince (*Inys*, or the island), a place which could only obtain its name by an elevation of the waters to the height supposed; and near the other end, but three miles farther from the sea than the termination of the valley in the Dee, as late as 31 Edward III., we find the abbot of St. Werburgh, in his plea to a quo warranto, claiming, among other manerial privileges, "Wrecum maris," in his manors of Broughton, Huntington, and Cheveley.

"As a last proof, whether the inferences drawn from these circumstances are correct, the soil has been examined in Chorlton, Coghull, and other parts of the valley; and about a yard below the surface it has been found to be uniformly composed of the same grey sea sand, as the ground which has been recovered from the Dee by embankments. A very considerable quantity of sea shells is also deposited in the gravel, which occasionally is found on the sides of the valley; and roads which have been covered with it appear plentifully bestrewed with sea shells and their fragments, after the surface has been washed by a shower." *

The alleged deviation of the river Dee referred to above has been ascribed to the Romans, whilst it is asserted by others that the present bed of the Dee, in its course from Aldford to Chester, bears no mark of art; and the mounds of earth thrown up in the vicinity of the river are attributed to the rude warlike purposes of our ancestors.†

In a note to the observations already quoted, Dr. Ormerod says: "Some other points remain to be noticed. If the reader turns to any old map of Cheshire, he will find a stream carried through from river to river between Wirral and Broxton, in the line which is here supposed to have been an

* Intro. Hund. Wirral., *Hist. Ches.* vol. ii., p. 187. The argument from the sand, shells, and gravel was withdrawn by Dr. Ormerod in 1854, vide *Journal of the Archit., Archæol. and Hist. Society*, Cheshire, part iv., p. 467.

† *Stranger in Chester*, pp. 171–172.

antient branch of the Mersey, and be surprised at the pains which have been taken to prove an established point; but the fact is, the designers of the maps have been misled by a brook rising near the middle of the valley, one branch of which joined the stagnant waters of the Gowy, near Thornton, the other flowed to the Dee, connecting the rivers indeed by a line of natural water, but not bringing them into confluence at so recent a period. This stream is mostly absorbed in the present canal." P. 188.

It is said this line of natural water is described by Leland and Hollinshed, besides being depicted on various old maps, by Speed, and in a Dutch map of older date published in Rotterdam. One writer says, that some centuries ago, Flookersbrook was covered over with water, and that a deep and broad channel flowed through Mollington, Stanney, and that direction, which emptied itself into the estuary now called the Mersey. Hollinshed, after tracing minutely the course of the Dee through Flookersbrook up to Stanney, distinctly states that it "sendeth fourth one arm to Stanine Poole and the Park side into Mersie arme," etc.* On these statements, I can only observe, that I have not succeeded in finding the passage alleged to be quoted from Hollinshed, himself a native of Cheshire, and apparently there is some misapprehension. The utmost I find in Hollinshed is a description of a "braunche of the ryuer Dee, which goeth in the meantime by Stapleford, Hocknellplat, Plemstow, and a little above Thorneton, crosseth a water that commeth from Chester, and goeth to Thorneton by the Baites, Charleto, Blackford, Crowton and Stoke, whereby Wyrall is cut frō the maine of England, and left as a very island."†

Lysons speaking more correctly says: Flookersbrook rises near Chester, and, running to Bach, there joins a

* *Chester Guide*, p. 13.

† *Chronicles*, vol. i., b. 2, fo. 64.

stream (now in great part merged in the line of the Chester Canal), which, in its course from Coughall, by Moston and Mollington, divides the Hundred of Broxton from that of Wirral, and falls into the Dee, a little below Chester.* This Flookersbrook is the stream called by Leland the Wyrall, "which ryseth within less than a quarter of a myle of Chester, and falleth into Dee at Flockersbrooke, without the north gate, wherein is a docke called Port Pole, for great ships to ryde at spring tyde."

The Portpool was contiguous to the stone bridge and the water tower without the walls, and is termed by Leland a dock, where ships could ride in his time at spring tides; the existing canal basin occupies part of its site. It was apparently the wide mouth of Flookersbrook.

That Chester was founded at the confluence of two streams is testified by the names of the City, of the River, and of the Estuary, if my interpretation of those names be correct.

Assuming that the Seteia Æstuarium of Ptolemy is the mouth of the Dee, the name signifies the estuary of two streams, being compounded of C. *sa*, a stream, and *deidhe*, (daya) a couple, or two things; the mutation of d into t being by no means unusual, and in this case more euphonious.

The name now borne by the river is phonetically identical with C. *di*, signifying two; the Welsh name of the river, *dwy-dwfr*, signifying two waters. The Scotch Dee is to some extent analogous. The city of old Aberdeen stands on a peninsula formed by the mouths of the Dee and the Don, that is, between two havens; the town of new Aberdeen is on the Dee only.

The name of Deva, the Roman name of the cities of Chester and old Aberdeen,—and, I think, sometimes applied

* *Magna Britannia, Cheshire*, p. 422.

to the rivers also,—appears to mean the two rivers or waters, from *di*, *bagh*, the *b* in compound words being aspirated, acquires the sound of *v*, and the aspirated *g* is mute; *bagh* is the root of bay, an inlet of the sea. The C. *di-abhan*, a similar compound, appears in the name of the county of Devon, from its position between the English and Bristol channels; but the name of Devon applied to a river in the shires of Perth and Clackmannan, a feeder of the Forth, appears to denote blackwater, *i. e.*, *dubh-abhan*; it is sometimes termed the Black Devon. The village of Devonby, or Dovenby, in Cumberland, not far from Cockermouth, stands between two streams.

I take this opportunity of correcting a former etymology of Ordevices, which I then supposed signified the neighbours of the *Black* coast, but which now seems more probably to signify the neighbours of the Di, and so applicable to the people of North Wales. Why it should be supposed that the name Dee is derived from *dubh*, black, is to me inexplicable, as I have not observed any special blackness in its waters about Chester and seaward, nor at Erbistock; any such blackness must be purely local, and probably due to dense foliage, or the colour of the river's bed.

Antiquaries, Historians, and Poets have combined through so many centuries to affix to Chester the epithet of "city of legions," it will doubtless appear as presumptuous to attempt a correction of the misconception to which it is due, as it will be difficult to remove the misconception itself. The attempt must, however, be made, as the real interpretation of the original epithets affects speculations on the ancient condition of the river. The name of Caer-leon has been supposed to signify the city of a legion; but the Welsh for legion is not *lleon*, but *lleng*. The real meaning of the Welsh *lleon*, or *llion*, is confluence, an aggregate of floods; and it will be found that the sense of a confluence is just as

applicable to Caerleon-on-Usk, at the junction of the Usk with a smaller stream called the Avon, as it is to Chester, making allowance for difference in the size of the main and tributary streams. To mark the difference between Caerleon-on-Usk and Chester, the latter was styled Caerleon-mawr, or Great Caerleon. Occasionally this epithet was changed to Caerleon-ffawr, which is commonly said to signify the same; but *ffawr* means a course, and doubtless its application had reference to the Roodee; which name looks like a phonetic representative of C. *rudh-di,* signifying the Dee-race. Analogous to this is the Roosdyche, near Chapel-en-le-Frith, in Derbyshire, which is described by Mr. Vale, as "an artifically formed valley, averaging in width forty paces, and thirteen hundred paces in length. It is mainly cut out of the side of the hill, to a depth of from ten to thirty feet, but where it is not so it is enclosed by banks of earth. On the excavated portion is a noble avenue of trees, oaks principally; at the west end is the meta, and at the east end the goal and other tumuli. The spectators were doubtless ranged along the banks throughout their whole length."* Mr. Vale terms the Roosdyche an ancient Roman chariot race-course, but the Celts must have had similar opportunities for acquiring in mimic fray that skill and agility mentioned by Cæsar. At Chester, no doubt, the spectators occupied the city walls, as at modern races.

The congeners of *lleon* are also confluent in meaning; as W. *llenwad,* a filling, a flowing; and *llenwi,* to fill, to flow in; and C. *lion-adh,* filling, swelling; *lionadoir,* a funnel; and *lionadh-mara,* the tide; literally, a filling-sea. The explanation of the error is supplied by another old name for Chester, that of legen-cester, which we are gravely told is the name conferred by the Saxons; the prefix, however, closely resembles C. *lag-en,* which signifies feeble water,

* *Trans. Hist. Soc. Lanc. and Chesh.*, N. S., vol. vii., p. 48. 1867.

and is the name borne by the river on which Belfast is built. That is a very sluggish stream; and above the weir, at the Mills, the stream of the Dee is also very gentle. In legencester, the letter *g* should be hard, and not soft. Another form of this so-called Saxon name is *legeacester*, or *ceaster*, which is nearly a synonym. Perhaps its more correct form was *legeasceaster*, signifying the military post on or near the feeble cascade. This form of the name is probably the source of the corruption into Leister, which appears in Leisterscire, one of the names for the county of Chester. The Welsh *llag* signifies slack; and from this word, or rather from its C. root *lag*, are no doubt derived the ordinary English words *lag* and *laggard*.

It is not at first sight apparent why the main stream was termed feeble, either as a stream or as a cascade, for possibly the weir is built on a shallow shelf over which the water glided with a gentle fall, more like a rapid than a cascade.

The claim of the Abbot of St. Werburgh to wreck of the sea in Boughton, Huntington, and Chevely, implies that at one time there was pretty free access for the tide into those townships. At springs, the tide flows above the weir, as far as Bangor Is-y-coed. If the other and minor stream be examined, some reasons may appear for the name given to the main stream.

Beginning with Blacon Point, Blacon appears to represent two C. words, *bla*, which signifies both sea and land, and *ceann*, head. There can be little doubt one of these renderings is correct. I believe it is universally conceded that the Cheshire side of the estuary was formerly along the line where the reclamations were commenced, and that this represents the ancient course for the tidal and upland waters. In Doomsday Book, Blacon appears as Blachecol, no doubt representing Blacoll, which also signifies sea-head, or headland.

The name of Flookersbrook, or perhaps more correctly Flockersbrook, is apparently from W. *Ffloch*, abrupt, quick; and *er*, an impulse forward; the whole name, fflooker, denoting a rapid stream, contrasting with the lagen, weak or sluggish, stream before-mentioned.

Proceeding inland, we pass Bache, which may represent a former beach, from C. *beach*, a kind of bed, and thence the bed of the sea, being, in fact, the mouth of Flookersbrook, opening into the estuary of the Dee, just as at the other extremity of Wirral the little township of Hoose has been formed out of the similar mouth of Wallasey Pool, when the flow was reversed as hereafter explained. The estuary of Flockersbrook, or Bache, also received the waters of two streams, one rising inland of Backford, the other above Great Mollington, which unite below Little Mollington, not long before reaching Bache, and now reach the sea through Finchett's Gutter.

The name of Molintone appears twice in Doomsday Survey of Cheshire, and on both occasions is spelt with a single *l*, and without the *g*; and though A.-S. scholars would probably assume that the name was conferred by some Teutonic tribe called the Mollingas, without adducing one tittle of evidence that a tribe so-called ever visited this part of the country, or ever visited England, or indeed ever existed, it appears to me much preferable to assume a Celtic root, for there is abundant testimony that people were within a short distance of this locality. The name, if my conjecture be correct, is compounded of C. *maol*, or *mol*, summit; *en*, water; and *ton*, for *dun*, a place; thus describing a summit-water place, *i.e.*, a place where the water lay at its highest level. And it may be assumed that the water flowed down to Little Molintone before there was any important descent. The two Mollingtons are now distinguished as Great and Little, but in former times they were styled Mollington

Torrant* and Mollington Banastre, distinctions which Dr. Ormerod derives from local families called respectively Torrant and Banastre. I believe, however, that many more men have derived their surnames from places than have conferred names on places, at any rate in ancient times; and that the Mollingtons are not among the exceptions to this rule; for, still adhering to the Celtic language, torran, without the final d, signifies a hillock, an eminence, such as there is at Mollington Torrand; and Banastre may be resolved into *ban*, bright or sparkling; *as*, or *eas*, a cataract or waterfall; and *tir*, Welsh *tre*, a region. Thus Mollington Banastre would be that part of the place at the summit water level which was contiguous to the bright or sparkling waterfall. At this place, then, the stream fell into a lower bed, down which it sped forward into the estuary of Flockersbrook, by the headland now called Blacon-point.

As there are not any locks on the Chester canal between the summit-level at Ellesmere Port and the same level at Chester, the surface of its water furnishes a convenient datum for comparing the levels of the contiguous country. In addition, I have been supplied with a copy of the Ordnance Survey, with a few levels inserted from the Ordnance datum. With this map in hand, I lately walked along the towing path of the canal from Ellesmere Port to Stoke, there diverging to inspect the bench-mark or level on the church-tower, and returning to the canal at Croughton. From this

* Variously spelt, as Torrand, Torret, and Torrant; Torran is the correct form of the diminutive of C. Tor or Torr. It is true that the name of Banastre is recorded in the Roll of Battle Abbey, and the owner is reputed to have founded a family at Newton-le-Willows, near Warrington. If this tradition be correct, it does not follow that Banastre was connected with Mollington Banastre. The family of the late Master of the Rolls is of Huguenot extraction, yet there is a place of the same name, Romilly, in Cheshire; and members of Lord Romilly's family, a brother and a son, have been engaged in business in Liverpool for some years. There is nothing to connect the family and the place, and the distance between Liverpool and Romilly is less than that between Newton-le-Willows and Mollington Banastre.

part forward, the canal appeared to enter a more elevated country, absolutely precluding all idea of any flow from the Mersey towards the Dee. I therefore mounted the hill to Wervin, expecting to find its further side skirted by the marsh land through which the Gowy flows; but, reaching a table-land, I proceeded down the side towards Picton, where according to the map was a bench-mark of 52.8 feet.* This mark I was unable to find, but the fall of the land is towards the Gowy. Near Picton Hall was a stream, the channel of which indicated the passage of a considerable volume of water at some time, but I soon found its source lay among the hilly ground near Upton; and so proceeding by Mickle Trafford to Chester station, I found the higher land continuous, in fact dividing the watershed into the Flockersbrook on one side and the Gowy on the other. Any tide which would flow from the Mersey into the Dee, as suggested by Dr. Ormerod, must have an elevation equal to the level of the water-surface in the canal, that is, an altitude of forty-five feet above the Old Dock sill, or of say 40.75 feet above the Ordnance datum. Such a tide would submerge nearly the whole isthmus, including Celtic settlements and Roman roads, and leave only the narrow ridge of high land from Whitby, by Backford, Chorlton, Caughall and Upton, to Hoole. Thus Hollinshed and the drawers of old maps appear more imaginative than accurate.

* For the data upon which these levels are given, I am indebted to the great politeness of Lieutenant Hill, R. E., Ordnance Survey, Chester. It may be convenient to give here Lieutenant Hill's note on the ordnance datum. The datum level for Great Britain is "the level of mean tide at Liverpool;" this datum-level, determined after a long series of observations, is .8 inches above the mean tidal level, obtained from the records of the self-registering guage on George's Pier, Liverpool. The mean level of the sea at Liverpool (datum above referred to) has been found to be .65 feet below the mean sea level round the whole coast of England and Scotland. To facilitate comparison between the ordnance datum and the local datum, that of the Old Dock sill, I may mention that the former is about 4.25 feet higher than the latter. The precise fraction is, I believe, still undetermined; for Admiral Beechey, when he requested me to check the two, stated that he had had it checked several times, but the results had never agreed.

It is well known that an Abbey of Cistercian Monks was founded at Stanlaw by John de Lacy, sixth baron of Halton, and Constable of Chester in 1178; but it appears from Giles' Survey of the River Mersey, 1819–22, that there is but a very small piece of the peninsula of Stanlaw, twenty acres, including the site of the abbey, which is above the level of a tide rising twenty-one feet on the Old Dock sill; and that the utmost altitude of the peninsula is only thirty-two feet above that datum, or six feet above the level of the highest recorded tide. It therefore appears pretty certain that the abbey was not erected in such a position; and the events which took place about a century later, and which led to the removal of the society to Whalley, confirm this supposition. After maturely considering all the scraps of information attainable, it appears to me almost certain that there was formerly a fresh-water lake in what is now called the upper estuary. This lake was doubtless much smaller than the estuary that now is, as the tidal waters have encroached largely on all the shores of the Mersey, where unprotected from their violence. Into this lake were collected the waters of the Upper Mersey, the Weaver, the Gowy, Holpool, Ditton Brook and other minor streams, and necessarily the water thus collected must have had one or more outfalls. There appear to have been at least two such outfalls; if there were more, all traces have been obliterated by the removal of the land, which, it is assumed, formerly connected Lancashire and Cheshire, and is now occupied by the arm of the sea, styled in old time brachium maris. One of these channels, I think, lay towards Cheshire, the other towards Lancashire. The name of the Sloyne, the favourite roadstead of the port, has not hitherto received adequate explanation; other forms of the name are Sleyne and Slyne, besides some trivial variations. The name appears elsewhere: a few miles north of Lancaster is a place of the

name, of which however I have not been so fortunate as to obtain clear information. Another example of the name is Slyne Head, in Galway, the Irish name of which is Ceann-Léimĕ, signifying, according to Dr. Joyce, the head of the leap, with of course an appropriate legend; but Donovan renders *leim* a rush of waters between rocks or clefts; and to the same roots, ceann-léime, Joyce ascribes the name of Loop Head, in Clare, which appears in the *Four Masters* as Leim-Conchullinn; but afterwards was more commonly called in Irish, as it is in the present, Ceann-Léime [*can-leama*].* It appears to me somewhat difficult to understand how Ceann-Léimĕ can have been transformed into Slyne; and I venture to suggest that, in the Mersey at any rate, the word Sloyne is to be traced to a different root, such as *easlinn*, that is, C. *eas*, a cascade or waterfall, and *linn*, a pool, that is, the pool of the waterfall or cascade. Such a word would naturally glide into a monysyllable; the prefix es being frequently clipt into s; and the pronunciation, Sleyne, Slyne or Sloyne, cannot be an objection, considering the various forms in which the name of the river Lune appears, in Lancaster, Lonsdale, Lune, and Loyne; the latter form of which is found in a newspaper fifty years old, in an advertisement for tenders for the erection of a bridge, and closely resembles the original Celtic form *lonn*.

A descent from the Mersey lake to the outfall stream is consistent with the supposition that an extensive marsh existed where the tidal waters now flow, between the Mersey lake, or upper estuary, and the sea. The facts which give probability to the existence of the marsh are: 1, the appearance of the coasts on each side of the Mersey entrance,

* *Origin and History of the Irish Names of Places*, by P. W. Joyce, A. M., M. R. I. A., 1869, p. 159. I cannot avoid expressing my surprise one so intelligent as Dr. Joyce should accept marvellous legends as bases for the names of places; for, in every case in which miraculous or magic power is invoked, the legend is obviously pure invention, to disguise ignorance and gratify the love of the marvellous.

as they would be found if denuded of sand; 2, the omission of any special mention of the Mersey by Ptolemy, who apparently includes it with the Ribble, Alt, and minor streams in *Æstuarium Belisama;* belisama, as I have suggested on a former occasion, denoting submerged sandbanks on the coast; 3, the description applied to the possessions of Wulfric Sprott, and the subsequent grant to Roger of Poictiers, *inter ripam et mersham.*

Though usually rendered between the Ribble and the Mersey, every schoolboy knows this is a very free translation of words which really mean between the river's bank and the marsh; that is, perhaps, the bank of the Ribble, and the marsh which formerly occupied the mouth of the Mersey, and bordered the seacoast and the estuary; but possibly the inland limit was not the Ribble, which must have been a very vague and indefinite boundary, but the line of the Douglas river, Sankey Brook, and the Mersey below the Brook, which are nearly continuous. I am aware some geologists assume that the bed of the Mersey is due to a dip in the strata which underlie it; but an examination of the soundings, I think, will show this supposition to be erroneous, and that the entrance to the Mersey has been excavated by the action of the tidal waters.

The narrowest part of the Mersey, between the upper and lower estuary, is from the Prince's parade to Seacombe point; through this gorge, or The Narrows, as it is sometimes called, the tide, at its greatest strength, rushes at the rate of seven miles per hour; here the greatest depth at low water of ordinary springs is from eight to nine fathoms, or say fifty feet; adding to this the height of the tide, will make a column of water eighty feet high, the friction of which at that surface velocity must be enormous; consequently it will be found, on reference to the charts, that the bed of the river in the middle of the stream is swept clean to

the rock. Where the river is wider, as between the Rock point and Bootle, the velocity is much reduced, though the depth is much the same; but the bottom, instead of rock, consists chiefly of gravel, with an admixture of shells. Above The Narrows the depth is rapidly much diminished, for the most part rising considerably above the level of low water springs, and the bottom consists almost wholly of sand with a little mud and gravel; in places the shores are of rock. Looking to the geological section as exposed on each side of the river, it will be seen that the formation may be broadly described as clay lying upon rock; and it seems not unreasonable to suppose that formerly this formation stretched across from side to side, especially as there is almost daily evidence of the way in which the rock and earth are removed by the tidal waters in that enlargement of their area, which has been proceeding for centuries, except in those places where artificial impediments have checked the operations of Nature. In this process, the material removed is reduced to its several mechanical ingredients; the strata of sand and sandy soil yield sand, the rock also yields sand, and the clay, stones, gravel, sand, and fine clay, which in this neighbourhood is usually if not always blue, and called blue clay; these materials are removed by the ebb tide, and deposited in various parts of the bed, according to their respective specific gravities. The coarsest gravel in the deepest parts and in the streamway; the sand in quiet nooks without the streamway, in what is termed slackwater; and the clay in creeks and inlets in which there is scarcely any perceptible stream, that is, at the level of spring tides. From the sand banks or sandy beaches, the sand when dry carried by the wind, forming those dunes or sandhills which are the distinguishing feature of the sea coast, and which for the most part overlie the original swampy and marshy surface of the land.

The foregoing characteristics being carefully considered, the history of some parts of the neighbourhood may be inferred with much probability of correctness; and so a deposit of coarse gravel may indicate the diversion of a rapid stream; sand, according to its form, wind-drift, water-drift, or the bed of a stream of moderate velocity; and the blue clay, a deposit in almost stagnant water at the top of the tide or stream. This order of deposit indicates a stream of some sort, either tidal or fresh, for the maceration of the constituents and their separate deposit could not take place in a streamless lake or bay; nor in a stream of uniform or nearly uniform velocity throughout its course.

Now, assuming that the marshes of Bidston and Wallasey were formerly united to those of Bootle and Crosby, there would be a large extent of land which for a considerable part of the year would be flooded by the upland waters; in dry seasons those waters would retire into their several shallow courses. Of one of these it is not difficult to represent its condition at that time; for there can be little doubt that, before the incursion of the tide, the waters of a part of Cheshire drained away through the present township of Hoose, where the forestial remains are found on blue clay. Wallasey pool presents this exceptional incident; its original embouchure on the Leasowe shore, by the indraft through Hoyle Lake, was protected from the assaults of the tide, and so, until the bed of the Mersey was eroded as high up at least as Birkenhead, the latest channel of the pool was not excavated; when, so to speak, the pool's flank was turned, it fell a victim to the invader. Otherwise, I conceive, the universal history is this, that the tide advanced, as it were, stealthily up the first shallow channel within its reach, thus the volume of water was increased, and of course the channel must either be widened or deepened; in most cases it was both widened and deepened; each successive series of spring

tides increased the advance thus made, until ultimately the whole area of the Mersey, between the sea and the Mersey Lake, was excavated, and "the arm of the sea" was prepared to seize, and eventually did seize, and occupy the lake itself. This process is to be traced in many of the inlets of the river, which were formerly petty tributaries; shallow streams long since obliterated. In some cases, as in Rimrose* Brook, an excavation was made to a depth of thirty feet, and subsequently filled up with arboreal alluvium nearly to its former level. In another case, that of the nameless stream that flowed through the site of the Prince's Park, Parkfield and Dickenson's or Woodhouse's Dingle, the excavation was made, but the filling up is probably, to some extent at any rate, the work of man. When the outfall sewer was constructed through Ullet Lane, the workmen came across the bed of a stream, with a gravelly bottom and some boulders, at a considerable depth below the present surface of the road, near to its junction with Alexandra Drive.

The material removed by the tidal waters in their advances would be deposited in the first instance in Liverpool Bay, thence called by the Romans Æstuarium Belisama, being their form of what the Celts simply called the submerged sandbanks on the coast. With the progress of the invasion, the width as well as the depths of the channels would be enlarged, and the deposits would be increased, until at length the sandbanks would be exposed at low water, and the dried particles on their surface, spread by the prevailing winds over the low lying marshes, were gathered by eddying gusts into the hills and valleys which are now so familiar; the most marked results being in the direction of the prevailing winds, that is, on the Lancashire coast, northwards from Sandhills, Bootle; whilst the Cheshire coast is

* C. *roimh ros*, wood-earth, derived doubtless from the arboreal deposit, like the name of Crosby; *i. e.*, *ce-ros*.

fringed with dunes, the marsh having little sand strewn upon it.*

This suggestive history receives confirmation from the names which still survive, if my analysis is correct. The Meolses of Cheshire and Lancashire indicate the level and extensive plains as they appeared to the original settlers.† Birkdale and Ainsdale do not indicate wooded and fertile dells, of which there are not any traces whatever, but the dales or allotments, in which the land was apportioned at some time or other, analogous to the appellation of Dalesmen, still retained in Cumberland. Nay, the very sandbanks themselves are witnesses as to the period at which they were recognised by name. Burbo bank being the sea-cow; Brazil bank, the false or pseudo isle; Dove point, the black point; Hoyle bank, the bank of the isle, that is, of Hilbre; and the Constable's sands, the treacherous foundation for the legend of St. Werburg's interference on behalf of an Earl of Chester, are the remains of a sand-formed lake. William Lancelyn (circa Rich. I. or John) quitclaimed for ever to the monks of the cell on Ilbre, the lake (meaning the fishery) of Hoyle Lake adjacent, under the description of "lacus de Hildburgheye, qui vocatur Heye-pol." Orm. ii. 275. Heye-

* Have geologists ascribed sufficient influence to the wind in the formation of sand-beds and sandy rock?

† Great Meols and Little Meols in Cheshire; North Meols, Ravenmeols, Erengermeles and Argarmeols, Maghull and Melling are all proximate to the great swampy plain or marsh which stretched from the Ribble to the Dee, broken only by petty streams, through which the upland waters filtered slowly to the sea. Meols and Maghull are referrible to C. *magh-ul*, or *ol*, signifying great plain. Melling appears to be *magh-ul-ynys*, the great plain island, and the knoll on which it stands would be almost constantly isolated in flood-season; while Ormskirk, formerly Ormiskirk, represents *or-magh-eis-kirk*, *i.e.*, the church of the people on the edge of the plain. Maghull has sometimes borne the name of South Mails, *i.e.*, Meols, as may be seen on two maps issued during the promotion of the Leeds and Liverpool Canal, about a hundred years since. One of these maps, engraved by J. Procter, is in the Binns' Collection I., 51; the other, bearing the name of J. Longbottom, engineer, was shown to me by Mr. Ecroyd Smith, not long since; neither map is dated.

pol is clearly ey-pol, that is, island-pool; and possibly this is the identical *can-stadh-beal*, or sand-formed lake.

The legend of St Werburgh was doubtless invented to disguise ignorance and to gratify pious credulity, just as St. Hildeburga was designed to explain the name of Hilbre. Take the h and a, her first and last letter, from the saint, and restore the name of the island to its original form, Ildebre, the island of the headland, and the saint, whose name is not found in any calendar, is relegated to the depths of that inner consciousness from which she was originally evolved. Hollinshed terms the headland Cape Ildebre, and irreverently stigmatises the believers in the saint and pilgrims to her shrine as "a sort of pious fools." In the charter to Chester from the Black Prince, Ildebre is called Arnoldseye, that is, *anall-des-i*, or the isle beyond the land; elsewhere it is termed Arnoldsheir, that is, *anall-des-eire*, or beyond the land's end. It is inexplicable that legends have not been invented, to relate how some one of the name of Arnold left his eye and his ear in such an out-of-the-way place.

Wallasey, as clearly as Wales, indicates aboriginal inhabitants, and that their land was an island when the name was conferred, and in Liscard is a connecting link with the Celts of Cornwall. Still, while the Celts predominated, the tide continued its advances. They are recorded in Liverpool (*li-feor-poll*, the sea-brink pool); in Mann Island (small island), probably a delta, afterwards the site for a battery;—a fort on Mersey Island did service with the Mardike, that is, sea-bank, in the siege during the Civil Wars;—in Pluckington Bank, C. *pluican*, signifying a small round head, and possibly very applicable then to the point on the southern side of the mouth of the pool, though now very inapplicable to the bank in its present discreditable magnitude;—in Toxteth (the landing-place at the stocks); in Otterspool (*otir-poll*, the pool of the seaward ridge), with its cascade in the

wood, *osceles;* in Humberdale in Garston, (*inbhear*, the estuary, as between Yorkshire and Lincolnshire,) and Hythendale.

About this part, I suppose, was the upper termination of the great marsh, whose original Celtic designation, *meirse*, marsh, has probably been supplanted by *muirsa*, sea-stream, similar in sound, and but slightly altered in appearance, and surviving in the name now given to the river.

On the Cheshire shore are Liscard (the high land above the sea), Birkenhead (*burr-ceann* the sea head), Tranmere (*trian-mor*, the summit district), Bebington (*babhan-dun*, the place of cows), and Bromborough (*brym-bri*, the headland at the brim, brink, or edge of the cascade (?), the letter *y* in Welsh taking the sound of *u* in English). It seems probable that the higher land between the mouth of Bromborough pool and New Ferry was formerly continued across to the similarly elevated land in Toxteth, between the Dingle and Otterspool; not that this partook of the nature of a ridge, but that the land here attained its greatest altitude, stretching southwards to Eastham and Speke, and declining northwards to the level of the marsh; the surface between the marsh and the lake being varied and undulating, like the contiguous land in the two counties, above and below.

So other eminences in each county broaden down to the level of the country which lay between the marsh and the lake, the north-western shore of which I assume to have stretched, say, from Eastham to Speke. It is possible the name of this lake survives in that of the river Weaver, *i. e.*, *oigh-bhior*, or great water; and in the stream Holpool, *i. e.*, *ol-pol*, or great pool; whilst the name of the Mersey has supplanted that of the stream which flowed past Thelwall and Warrington, bringing the waters of the Irk, Irwell, Medlock, Bollin, Etherow, and Tame into the lake. I have been informed by Mr. Beamont, of Orford Hall, there are

several fields on the banks of the Mersey, near Warrington, which each bears to this day the name of Anglesea; which I apprehend represents C. *an-geill-sa*, that is, the woodland stream; a name not inappropriate, even now, at Thelwall, Lymm, and I think other places on the upper part of the river's course.

As from the lake there was an overflow on the side next Cheshire, which took the form of a cascade, the existence of which is recorded in the name of the existing Sloyne, so on the Lancashire side was another overflow, taking the form of rapids, in which the current churned the water into foam, and hence the name of Speke point, from C. *speach*, or *speich*, froth. In this part of the river are preserved the names of three points or headlands, the physical resemblance to points being almost lost; of these Speke point, no longer in existence, was one; the others are Dungeon point, C. *daingean*, a stronghold, an enclosure, originally a place for cows, and as such preserved in Ireland; it appears also in the township of Croghton in Wirral, in which Ormerod says is a very romantic dingle called the Dungeons. The third point lay between Speke and Dungeon, and was appropriately named Oglet, C. *og*, a point, and *leat*, middle.

In addition to the two overflows I have suggested, it is manifest there may have been more, of which not a trace survives; but these two would be sufficient to effect an important change in the lake in the course of time, that is of centuries. Passing, as it may be assumed they did, through diluvium, as exhibited in the natural sections of the land on either shore, the constant friction would deepen the channels, and so the level of the lake's surface was gradually reduced, and eventually the peninsula of Stanlaw would present a very pleasant site for religious retreat; by its position isolated from the world's approach, and enjoying

beautiful lake scenery, bounded by the Peckforton Hills, Halton Hill and Castle, Runcorn and its Castle, Hale and Halewood, with Woolton and Rainhill in the background; and it is easy to understand why the founder of the Abbey, perhaps sometimes weary of worldly strife, deemed it might prove a very blest retreat, and so prescribed it should be for ever called Locus Benedictus.

The names of the townships of Stanney and Stanlow appear indicative of their suitableness for dairy farms, conjectures confirmed by the more modern appellation, still borne by the Abbey Grange, of Grange-cum-cow-worth, that is cow pasture. Stanney appears to be derived from C. *es-tamhnach* (estawney), ox pasture of very superior quality; and Stanlow to be a contraction of *es-tamhnach-lo*, the ox-pasture by the water.

In 1178, there could not be any anticipations of insecurity, for doubtless the Northern overflows from the lake were then amply sufficient to carry off all flood and other land waters to the arm of sea, still some miles distant; the approaches from which were so confined as to prevent the access of tidal waters, and the level of that water would be so much lower than that of the lake, as to be wholly unsuggestive of danger. But year by year the sea gained steadily, not only on the Great Marsh, but even on the higher land beyond; the surface of the lake also declined; the Sloyne cascade became a rapid, and the rapid a swift stream, until, in 1279, a reverse came, — and it is written, — Mare erupit iii. non. Februar. die S'tae Werburgæ, et incredibilia mala fecit apud Stanlaw et alibi; insuper pontem Cestriæ confregit et asportavit, cursum solitum supra modum excedens.* Eight years after, the great tower of the church was thrown down in a violent

* Ormerod ii., 219. Gastrell's *Notitia*. Whitaker's *Whalley Abbey*. The Coucher-book of Whalley.

storm; two years later the greatest part of the Abbey was destroyed in a conflagration; and in the same year the lands of the Abbey suffered so severely in a second inundation, that an indulgence of forty days was granted to all who assisted the Abbey by contributions. Under this combination of disasters, the brethren represented to Pope Nicholas IV. the inconveniences of their situation, that the waters rose three feet high in the offices of the monastery, that access was altogether unsafe from inundations, and total destruction threatened their buildings from the fury of the tides, and they prayed permission to remove. Their request was granted, and after some hesitation they appear to have declined a site in Toxteth, offered by Duke Thomas of Lancaster, and settled at Whalley, retaining Stanlaw as a cell. By this time, the close of the thirteenth century, it is manifest that the tide had access to the lake; how much time elapsed before all the obstructions to a full and free passage were removed is unknown; but any one may observe that but little enduring resistance is offered by the clay banks on either side of the river, nor even by the friable sandstone rock, large masses of which are sometimes broken off and gradually dissolved. The boundaries of the tidal waters are enlarged, many hundreds of acres of valuable land disappear annually, and their constituents contribute to the rapid growth of the sandbanks in the upper and lower estuaries, and of the sandhills on the sea-coast; increasing the difficulties which attend the navigation of the port; a foreboding Nemesis, threatening ruin for neglect and inattention.

Of the aqueous condition of the neck of land between the Mersey and the Dee, there is abundant evidence in the names which are recorded, or still subsist, and in a few facts and incidents. Such names as Ince, Poole, Helsby, Elton (water-places), Frodsham, the Traffords (C. *treabh-*

foras, village ford), namely Bridge Trafford, Wimbald's Trafford, and Mickle Trafford, all relating to one ford; Chorleton, Picton (fork place), Wervin, Tarvin (bull-water), Moston, Moreston, Mauricaceston,* (the great tribute and water place;) Backford (swine-ford), the two Mollingtons, Bache, Flookersbrook, and Blacon, are all indicative of water of some kind, salt or fresh, running streams, cascades and swamps. Then in the Coucher Book of Whalley, mention is made of pools and streams which no longer exist, or remain under different names, the alterations in those names the result of changes which render identification difficult, if not impossible. They are the water running from the mere of Grunelles in Stanney, on which Alexander of Bunbury grants the brethren permission to make a fish-yard, with liberty of fishing in the mere whenever they please; but does not concede, nor give, nor sell the mere; he reserves to himself and his heirs half the fish-yard, and of the take of fish; and also option to erect a mill upon the said water-course, when and wherever they please; probably Stanney mill is evidence that the option was exercised. In a document belonging to the year 1270, mention is made of a certain old fossatum; in 1262, Robert, Lord of Pulle, surrenders, for xij. silver pennies annually, all that pasture between the bounds of the Abbey and his own, *i. e.*, as Mersepull descends into Londepull (a translation of Gowy, the name now in use), where two posts are fixed, extending lineally as far as the line of the waters of Merse. It is provided, that if it should happen that the said pasture is wasted by the violence of the sea, so that the Abbey

* In the original grant to Stanlaw: later, part of the possessions of S. Werburgh, possibly by exchange. Butter hill, in Moston, manifestly represents C. *bothar* (boher), originally a road for cattle, but with a wider application subsequently. If the traditional explanation were founded on fact, why should butter of all articles confer the name? In Ireland bothar appears as *batter* and *botter*, as well as in other forms. See Joyce's *Origin and History of Irish Names of Places*, pp. 42 and 388.

cannot have the use of it, the rent shall cease until they regain the use. In 1209, the houses of S. Werburg and Stanlaw agree that Alfrichesholm, probably the same as Aldrichesholm (? old rushes), may remain to Chester wholly and peaceably; that Stanlaw shall have in perpetuity all the land and marsh lying between Holmlake and Holpul, as they descend in Teruen (Tarvin), and there make, if they please, a fishery and a fulling mill, and all appliances and easements which can be had without injury to the mills and fisheries of the Monks of Chester; and without retaining or changing the course of the said waters; and that Stanlaw will not raise their mill-dam above the same Pul. That if their said water-course, as is wont, may have been changed by inundations, they will be permitted to put their mill wherever on their own land it could have been placed before this composition. Also, if the higher mill of the Monks of Chester, from violence of the waters, instability of the land, or any other cause, shall be destroyed, and cannot be secured in the place where it now is, they may be permitted to remove their mill to any suitable place, below the said Holmlake and Holpul, on the water of Teruen, wherever they may see fit, and to attach and secure it to the land of the Monks of Stanlaw. Also, if at any time it may please the Abbots and Monks of each House to make a fishery below the mill of the Monks of Chester, each House may do so on its own mediety, and on its mediety of the appurtenances.

The Monks of S. Werburgh's appear to have had at least two mills at Ince, on the waters of Tarven.*

In 1261 and 1277, other compositions between the two Houses speak of marsh lying before the gates of Stanlaw, in breadth from Londpul or Elpul, directly by a certain

* Ormerod, ii., 12.

old lake as far as Whitby-pul, and in length as far as the water which is called Merse.

When the tidal waters first reached the lake, their approaches would be very narrow, and therefore the tides were probably heaped up to some extent, as they are at Chepstow and elsewhere; thus the allegation that the tide rose three feet in the offices of the Monastery loses its apparent improbability.

It appears there are three epochs in the history of the Mersey-lake — 1, including the Roman period, when the lake contained fresh water only, and filled a basin which then lay in the midst of the marsh, between Hale in Lancashire, and Ince and Stanlaw in Cheshire; its normal level being, say, eighteen or twenty feet above Old Dock Sill, and the excessive waters flowing seawards through the low-lying lands, which then occupied the present mouth of the Mersey; 2, when, through the erosion of the outfalls — cascades or rapids — the surface of the lake had been lowered to, say fifteen feet above Old Dock sill, and, consequently, its area diminished; 3, when the tide broke into the lake, and added its area to the sea.

It may be assumed that Ethelfleda, daughter of Alfred the Great, erected or fortified the Castle of Runcorn, and that her husband founded Thelwall, before the close of the first epoch, when the waters were at their highest normal level, and before they were subjected to tidal fluctuation, as otherwise the fortresses would be much less secure.

The name of Thelwall has been derived from A.-S., *thel-wall*, the timber town, from the trunks of trees supposed to have been used in its construction; but in those days timber was so extensively used for this purpose as to render it highly improbable that the distinctive appellation was thence derived; and it seems to me more likely that its founder gave to the new town the prænomen of his wife's family, and that

it was originally styled Ethelwalla, and subsequently contracted into Thelwall.

The name of Runcorn also appears to be A.-S. in origin, and formed of *rum-coren*, the chosen place, assuming its present form in conformity with that rule of English speech under which m before c hard becomes n.

Runcorn and Thelwall are reputed to have been founded about 915, Stanlaw Abbey was founded in 1178, or near the close of the second epoch; in the red book of S. Werburgh's Abbey, a petition is recorded, setting forth that *in Wyrall and in their manor of Ynes, they had lost by the inundations of the sea, thirty carucates of land, and were daily losing more.* The precise date of this document is not given, but as it was addressed to Hubert, who was Archbishop of Canterbury from 1193 to 1207, it must belong to some part of the intervening fourteen years. One hundred and fifty years after, the Abbot of S. Werburgh claimed wreckage in the manor of Ince, in a plea to a quo warranto, 31 Edward III.*

During the second epoch, it is very probable that the surface of the lake was below the level of tidal high-water; it was, however, so distant from the then tidal limit, it appeared secure from the encroachment of the sea; but the wearing away of the land allowed the tidal limit to advance nearer and nearer to the lake, until it was finally absorbed. The general level of the Mersey marshes, adjacent to both the upper and lower estuary, is recorded by Giles as ranging from fifteen feet upwards above Old Dock sill. Consequently the level of the water at the tidal limit during the first and second epoch was below that of high water, the surface of the sea inclining shorewards. This sort of difference is by no means unusual in tidal waters, though the direction of the plane may vary. Mr. Rendel found, for example, that at Ellesmere port, the surface of the tide

* Ormerod, ii., 12.

was thirteen inches higher than at Liverpool,* a difference which would be actually greater at the time of high water at Ellesmere port, as at Liverpool the ebb had advanced.

The second period seems to have closed about 1279, and the river to have received that regimen which has now ruled for six centuries, subject to such variation as has been produced by tidal action, weather, and the works of man, through the embankment of marshes, the erection of weirs, jetties, piers, and groynes, and the construction of docks, and of entrances to inland navigations.

That Wallasey pool has undergone the metamorphose suggested above is highly probable, as in 1850 the remains of an old oaken bridge, crossing the rocky bed of a brook, were discovered in Birkenhead, on the line of the ancient road from the ferry to Bidston, at a depth of fourteen feet below the surface of the ground, or say, fourteen feet above the Old Dock sill, and of nine feet below the level of a tide rising twenty feet on the Old Dock sill, that is nearly five feet below the ordnance datum. From Giles' survey, 1819–22, it appears that the surface of the bridge, or roadway, was convenient to that of the adjacent marsh. A detailed account of this bridge was compiled by the Rev. W. H. Massie, of St. Mary-at-Hill, Chester, from notes supplied by Mr. Snow, then resident engineer for the bridge, which has been built nearly on the site of the ancient structure at Bridge End. The discovery was made in excavating the foundations for the modern erection. Mr. Massie's account is printed in the *Journal of the Architectural, Archæological and Historic Society, Chester*, Part 1, pp. 55—60, and 68—76. He ascribes the erection of the bridge over the then existing stream to the Romans, but it does not appear that conclusive evidence on this point is attainable. It seems to me highly improbable that the inhabitants of South Britain were the

* Webster's *Port and Docks of Birkenhead*, i., 77, Rendel's evidence, 1844.

uncouth savages they have been described, even before the Romans had held sway for four centuries; after that period they must have been educated and improved by intercourse with a people so civilised. This bridge may have been constructed before the Roman advent; during their stay, just as in modern times Europeans have designed or erected similar structures for military purposes, or for the natives of countries they visited; or it may have been built after the Romans left. Mr. Massie, of course, refers the depth at which the bridge was found to subsidence of the land. I think those who realise the grand results produced by the regular action of ordinary processes will prefer the suggestion I have offered above, as more probable than interjectional and hysterical violence. It appears there has been a succession of bridges at the place where the ancient bridge was found; one appears on Giles' survey, crossing a brook which had been elevated as the land was elevated by deposits.

On the suppositions adopted by Mr. Massie, of the bridge being the work of the Romans, at least one subsidence has taken place since its erection: the question naturally arises, To what cause is that subsidence to be ascribed? It cannot be volcanic, if the hypothesis received by geologists is correct, which assigns a much more remote period to the latest ebullition of volcanic energy in the British Isles. If volcanic, other traces would surely be discoverable.

It would be straying beyond the scope of this paper to attempt to forecast the future; if the history of the past is rendered more intelligible and interesting, the writer's object will be attained. There is yet scope for the topographer and the antiquary, whilst for the geologist the ground is almost unbroken.

THE JURY SYSTEM.

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It was with considerable hesitation that I placed my name in the hands of our worthy Secretary, as one willing to read a paper before this Society; and, had it not been that he declined to let me off, I should even now have left a clear field for some other member, who would more worthily have occupied your time than myself.

When again I considered that among our members we reckon men who, on literary, philosophical, and scientific subjects, are no mean authorities, I was still more doubtful what to choose for my subject, for I felt that I should do a rash thing if I ventured on their preserves. I determined, therefore, that my paper should be upon a subject which, while of vital interest to each and all of us, both collectively and individually, as men and citizens, would be one on which I might be able to give some information, and at the same time break into somewhat new ground. In choosing the Jury system, I felt I was selecting a subject that was exciting some interest at the present time; and as the Bill now before Parliament proposes to modify and alter that system to a considerable extent, it was one to which your attention might be drawn with advantage. In order to place this clearly before you, I propose to briefly trace the history of this system, commenting on the different phases it has passed through, and the various attacks it has sustained, down to the present time; to show how it now stands, and what are the modifications proposed to be introduced by the Bill now before Parliament.

In doing this, I shall have to draw your attention to some cases which caused some stir in the political world, but as they will be merely cited in a historical point of view, I trust I may do so without infringing one of the salutary rules of the Society.

The early history of Juries is very vague and uncertain. That it is of great age is certain, though where it actually began is not yet determined. Some authors have endeavoured to trace the original to the Ancient Britons. It is certain the system was known among the earliest Saxon Colonists. Bishop Nicholson (*De Jure Saxonum*, p. 12,) ascribes the institution to *Woden* himself, their great legislator and captain. Blackstone, vol. iii., p. 349, states that traces of juries may be found in the laws of all countries which adopted the feudal system, who had all a tribunal of twelve good men and true.

Dr. Stiernhook ascribes the invention of the jury, which in Teutonic languages is called *nembda*, to Regner king of Sweden and Denmark, contemporary with our Egbert, about the year 827. *Wilkinson* states that the first actual mention of it in England is in the laws of Ethelred, about the year 866.

It is ordained in the statute De Monticolis Walliæ, chap. iii., that "duodeni legales homines quorum sex Walliæ et sex Angli erunt Anglis et Wallis jus dicunto." It is also spoken of at the same time as not a new invention. A recent work, Turner's *History of the Anglo-Saxons*, vol. iii., p. 323, remarks that "no record marks the date of its commencement." While Hallam and Reeves have very grave doubts whether trial by jury actually existed before the Norman conquest.

Serjeant Stephen, in his work on Pleading, states that there is some evidence of an occasional existence of an Inquisitio patriæ, or Inquisition by a Jurata of twelve,

before the Norman conquest. It is also clear it existed among the Scandinavian ancestors of the Normans.

Coke, Selden and Spelman, and also Blackstone, believe in its existence among the Anglo-Saxons.

The most probable theory seems to be that it was derived by the Normans from Scandinavia, where the judicial number of twelve was always held in great veneration.

To quote Blackstone — the truth seems to be that this tribunal was universally established among all the northern nations, and so interwoven in their very constitution that the earliest accounts of the one give us also some traces of the other.

However this be, it is now considered that the long-cherished idea of attributing the foundation of trial by jury to Alfred the Great cannot be maintained, and is only on a par with the Greeks attributing nearly every marvellous deed of prowess to their great Hercules. I am not far from the truth when I say that in all human probability this is an institution that has been known in our country for *a thousand* years.

The Emperor Conrad, shortly prior to the Norman Conquest, declared, nemo beneficium suum perdat nisi secundum consuetudinem antecessorum nostrorum et per judicium *parium suorum.*

In the time of Henry II. a particular form of it, called the *grand assize,* was instituted in Parliament. A writ was sent to the sheriff to return four knights; who were to elect twelve others, and these sixteen were to form the grand assize or great jury, which was to try the matter of right. Glanvil, who advised the measure, probably devised it as a means of stopping, in certain cases, the "barbarous and unchristian custom of duelling," very copiously described the mode to be adopted.

In an assize of "Darreign presentment," in the reign of

Richard I., the Jurors find a special verdict in these words: "Assisa dicunt quod *nunquam viderunt* aliquam personam," &c., &c.*

Again, in an assize of novel disseisin, in the same reign, these words occur: ". . . . Juratores dicunt quod *non viderunt* unquam aliam," &c.

Also, Consideratum est quod alii Juratores eligantur qui melius sciant rei veritatem.† Also in the reign of John is an instance. Bracton (216, a.) cites a case.

In the reign of John it was definitely established by the Great Charter. It is more than once insisted on as the bulwark of our liberties; but especially in the famous twenty-ninth chapter. "No free man shall be taken or imprisoned, or be disseised of his freehold or liberties or free customs, or be outlawed or exiled or otherwise destroyed; nor will we pass upon nor send upon him *but by lawful judgment of his peers*, or by the law of the land. We will sell no man; we will not deny or delay to any man right or justice."

From Bracton's work, in the time of Henry III., we find it had taken among us the shape it now wears substantially.

To make one more quotation. "But I will not misspend the reader's time in fruitless encomiums on this method of trial, but shall proceed to the dissection and examination of it in all its parts; from whence, indeed, its highest encomium will arise, since the more it is searched into and understood the more it is sure to be valued.

"And this is a species of knowledge most absolutely necessary to every gentleman in the kingdom; as well because he may be frequently called upon to determine in this capacity the rights of others his fellow subjects, as because his own property, his liberty and his life depend

* Plac. Ab. 8, Norfolc.

† Plac. Ab. 11, Wiltester.

upon maintaining in its legal force the constitutional trial by jury."

One very important circumstance must not be lost sight of, and that is, that in early times the jurymen were witnesses as well as jurors; that is, that they were to be cognizant of the facts of the case, and to be guided by that. *Now*, if a juryman has knowledge of the facts of the case before he comes into the box, he would be shut out of it.

Then they gave their testimony as to facts which they had antecedently known; *now*, their judgment upon the evidence laid before them. *Fortescue*, towards the close of the fifteenth century, considers the jury in the light of witnesses. Mr. Justice Vavisor, in the 14th Henry VII., states it as clear the jury may find their verdict without any evidence.

In that interesting old book, *Doctor and Student*, published in the sixteenth century, I find the following curious passage: —

"If one of twelve men of an inquest know the very truth *of his own knowledge, and instructed his fellows thereof*, and they will in no wise give credence to him, and thereupon, because meat and drink is prohibited them, he is driven to that point that either he must assent to them, and give their verdict *against his own knowledge*, and against his own conscience, or die for lack of meat, how may the law then stand with conscience that will leave an innocent in that extremity, to be either forsworn or to be famished and die for lack of meat?"

Instances occur in 34th Henry VIII., in the case of Rolfe *v.* Hampden; and as late as James I., and even of Charles I.; but about the time of Charles II. this had ceased.

The process used to be, that when issue was joined between the parties a writ was issued to the sheriff, commanding him "to cause to come *here* (to the place of trial) twelve liberos and legales homines, free and lawful men of

the body of his country, by whom the truth of the matter may be better known, and who are neither of kin" to the parties, "to recognise the truth of the issue between the parties."

Sir Matthew Hale breaks out into a panegyric on this, saying how admirably this constitution is adapted and framed for the investigation of truth beyond any other method of trial in the world, the person returning the jurors being a man of position above suspicion; the fact that the parties would have notice of the jurors, and so opportunities of judging of them, and by the due notice there would be no lack of jurors; thirdly, that the jurors appear where the case is to be tried, thus saving expense; and lastly, that the judges are above suspicion.

It must also be borne in mind that juries in those early times were very little if any protection to a prisoner, and absolutely none to a state prisoner. This may appear strong language, but on a little investigation will prove to be correct. Thus, when a prisoner was put upon his trial, the jury were sworn in, his fate absolutely depended upon their verdict, and he should be allowed to have some voice in their choice. This was done by what was called challenging the jury, and might be either *to the array*, that is, to the whole panel prepared by the sheriff, or in capita, that is, to the individual juror which might be in propter honoris respectum, as against a lord on a jury.

Propter defectum, or legal incapacity;

Propter delictum, or on the ground of a criminal sentence; or

Propter affectum, or interest for or against prisoner.

The law in later times was so careful of this that a prisoner was allowed to challenge twenty jurors peremptorily, or without assigning any reason. This right of challenging was of inestimable value, as a prisoner might otherwise have

been judicially murdered by a packed jury. In the time, however, of the great Lord Coke, this right was not only not allowed, but refused, to a state prisoner. No challenge was allowed by him, and no counsel was allowed to him. And, even more than this, no witnesses were allowed to be called by the prisoner in his defence against the Crown.

Thus, even on the trial of Sir Walter Raleigh, no counsel was allowed him, and he had to defend himself against the virulent abuse of Mr. Attorney-General Coke. The jury only retired fifteen minutes, and, of course, found a verdict of guilty.

In case the judges were inclined to be gracious, they would allow (perhaps) a prisoner to challenge jurors for cause shown, but would not allow one peremptory challenge. Trials by jury then were only a certain method of safely getting rid of obnoxious characters.

As the judges became more independent, and as the people grew in strength, juries became year by year more independent, and more true to the spirit of the constitution; and various laws follow in the statute books, regulating the qualification of jurors, both for special and common jurors. The sheriff was called upon to make up the lists, and he was ordered to return *boni et legales homines,* these being the technical words for men of some property—substantial men—and not merely men untainted with crime. This formula was always adopted, so that a statement that was used in the recent debate on the bill now before Parliament—that trial by common jurors only, was unconstitutional, as it had never been contemplated by the law—is substantially true. None of what are now known as common jurors would come under the head of *boni et legales homines.*

One other very important point must be noticed in the functions of a jury. It will be remembered that at first jurors were the witnesses of the event; that then they

gradually ceased to be witnesses, but had to judge of the facts laid before them, or, to use a technical phrase, the jury had to decide the facts upon the evidence laid before them.

The jury having found the facts, the judges declared what the law was on those facts, and pronounced sentence.

As, of course, the verdict of the jury was given on the evidence laid before them, rules of evidence speedily grew up which regulated the evidence, and decided what was admissible and what was not—as, for instance, that hearsay evidence is not admissible. The wisdom of this rule is so evident, I need not descant on it. It thus happened that the jury and the judge occasionally differed; and, when the judge, following his duty, directed the jury that the facts proved would support a conviction, and that they must find a verdict accordingly, the jury refused.

This has been a leading maxim in our law from early times. In Coke upon Littleton, it is referred to as established. It is there laid down most positively that it is the solemn duty of the judge to find the law, the solemn duty of the jury to find the facts; and that neither can in any way interfere with the prerogative of the other.

Or to quote the old maxim—

> Ad quæstionem facti non respondent judices,
> Ad quæstionem juris non respondent juratores.

If the jury obstinately refuse to receive the law from a judge, or find their verdict through a mistake of the law or facts, a new trial in civil cases will be granted.

It must also be noticed that there is the greatest difference between civil and criminal cases. In the former, merely property is in question; in the latter, life, liberty, lands, and, in former days, attainder of blood, and loss of all civil rights. The mode of a trial is practically different, for whilst in a civil case it is perfectly justifiable that witnesses should only

be called to prove certain facts, which are only of interest to the parties, in a criminal case every witness should be called who knows anything about the matter, the desire of every one being that the truth should be arrived at, and not that a conviction or acquittal should be obtained.

One curious effect of the jury being bound to take the law from the judge is this:

The law is of necessity a slowly changing body. Public opinion goes before it, and after many years the law is repealed or altered. The juries, being an index of public opinion, go faster than the law, and, knowing what the law is, in many cases take the matter into their own hands by refusing to find a verdict. This is notoriously so in the case of capital offences. Public opinion is changing on this subject, and, juries representing this, again and again refuse to convict on the clearest evidence.

In cases of infanticide and most murder cases, not guilty on the ground of insanity, is becoming so universal, that the advocates of the abolition of capital punishment boast that the total repeal of the death-laws cannot be far off.

Again, in Ireland it is more apparent than in England. In a case in the paper last week, a jury openly avowed their belief in the evidence, which clearly proved the prisoner guilty, but refused to convict.

Still, for all this, a jury of twelve men, who come to the box fairly and honestly to do their best in the trial of a prisoner, without fear of punishment or hope of reward, is such a grand and noble institution, and such a bulwark of our liberties, that, in spite of all its faults, we as Englishmen are proud of it, and glory in its fame.

When we turn to a civil jury, it is rather different. Where no great question of rights and wrongs is in dispute, but only a question whether A. owes B. £1,000, or whether C. ought to have delivered so many bales of cotton to D., the

composition of a jury is quite another thing. There is now no question of sentiment, no great question of public duty involving great principles of politics and morality, but only, so to say, dry practicalities, connected with the routine of life. What should be the chief qualities of a jury to decide in a case say of non-delivery of goods? Intelligence, despatch of business, and a verdict delivered as soon as possible, with as little expense as possible to the parties, and the least inconvenience to themselves.

Now, is this obtained now? A great number of jurors are summoned, are kept kicking their heels about the courts, are taken away from their callings, and for a miserable pittance, which does not recompense them for an hour's absence. Is it to be wondered at that verdicts from juries in civil cases, especially where any question of money damages is at stake, is a toss-up, so to say, and that the amount to be given is frequently decided by mere chance, or by lot. The jurors are impatient to get home after a laborious day's work in a crowded court, and, instead of fighting out their verdict in a proper manner, in very many instances decide money damages by adding the lowest and highest amounts together, and dividing them.

In very many civil questions, suitors would, in my opinion, prefer to have their cases settled by an independent arbitrator, rather than by a jury. As a fact, arbitrations are becoming more common every day, so many commercial questions can be better decided in a room before an intelligent arbitrator, than in a crowded court before a jury.

Again, look at the intolerable delay and expense occasioned to all parties if the jury cannot agree on their verdict, in some cases proving almost ruinous to the unlucky suitor.

These are a few of the reasons which called forth the remark in Parliament, that some legislation was necessary, in order to revive the waning prestige of juries.

This was felt to be so necessary that legislation has been tried on the subject, five or six acts having been brought in to remedy it, in as many years. As most of you are aware, a select committee met in 1870, and the bill now before Parliament is the result of their labours. The Attorney-General, in bringing it in, stated he disagreed with some of the recommendations of the committee, and should move amendments.

The remedy he provided for the evils attending the jury system were shortly these—

1. Reduction of the number of the jury from twelve to seven.
2. Composite juries.
3. Unanimity of verdict.
4. Qualification of jurors.

These are the principal; there are one or two smaller points, which I will notice in due time.

As to the reduction of the jury—

The Attorney-General announced he should propose to leave juries alone in the cases of trials for treason, treason-felony, and murder, but in all other cases should propose to reduce the number from twelve to seven.

He urged, in support, that there is no magic in the number of twelve; that it does not prevail everywhere, even in England, or the more prosperous of our colonies, or even in Scotland; and that we have for years been trying it in England, in the county courts, where the jury is only *five*. In Scotland, a criminal jury is *fifteen*.

I believe I have fairly given the arguments in favour of the reduction of the number. In the first place, there seems to me to be a great distinction between civil and criminal juries. Where a question of life and liberty is at stake, the utmost care should be taken; and I would sooner let ten scoundrels off than hang one innocent man.

This view is recognised by retaining the number in treason, treason-felony, and murder. The first is almost a dead-letter; the second is hardly a severe offence, judging by the light sentences. Now, as to murder. In very many cases, the dividing line between murder and manslaughter is almost imperceptible, and though capital punishment is not the sentence for this latter, still, large terms of imprisonment, for twenty years or more, is a sentence very little less dreadful than that of death. In the one case, a prisoner would be tried by twelve men; in the other case, he might be sent to a sort of living death by seven. Again, there are many offences which require heavy sentences — such as arson, and the like. In my opinion, the criminal jury should not be reduced in number.

In civil cases, it might be, in some cases, with advantage. The county court judgments, with a jury of five, work very well, but, as a rule, the cases are of small importance. Any suitor who could afford it would go to a higher court.

I think the labours of the grand jury might, perhaps, be more thoroughly done than in many instances they are; and cases might be more sifted before they go to a common jury; but, I must say, I view with dislike and distrust the abandonment of a number so time-honoured and long tried as that now found in the criminal jury box.

That the juries should be improved is a great desideratum, though the rather startling statement, that the lower prisoners had really no trial by their peers, is absolutely true.

The composition of juries is the next point in the bill. It is proposed to greatly modify the qualification of jurors, and to have all special and all common jurors on one list, but distinguished with the letter S for special, and C for common; but that all special jurors should be liable to serve with common jurors, and that no jury should be a good one

that had not a certain number of special and a certain number of common jurors.

It is hoped by this means to get more intelligence into the jury-box.

It seems to me this scheme is utterly impracticable. In the first place, I do not believe there would be unanimity of feeling between the jurors, but the tendency would be for the specials to go with one another, and the commons with one another, and so to make a verdict almost an impossibility. The feeling would be either that the specials were dictating to the commons, or that the commons were bearding the specials.

Again, the rate of payment would be another objection. Two men sitting side by side in the same box, hearing the same case, listening to the same speeches, should properly receive the same fee. One would receive, perhaps, two shillings, and the other twenty-two shillings. Would not this be a fresh reason for difference between the jurors? By our old law, some of the jury had to be returned from the place where the cause of action was laid in the declaration, and if none were returned the panel was bad. This was found to work so badly that the number was gradually reduced from six to four, to two, and at last abolished altogether. The same result might often arise if a fancy selection of jurymen were resorted to.

The next and most important point is the question, Whether or not the verdict of a jury should be *unanimous*? We can all of us say, with the Attorney-General, "Why should one pertinacious, wrong-headed, cantankerous man be able to veto the reasonable conclusion of any number of persons?"

This question hinges on the *number* of the jury. Thus if the vote of the majority be taken of a jury of twelve, there would in most cases be little objection to it. Indeed

it is occasionally done now, by consent of the parties. But suppose the jury is seven only, would we be content with the votes of *four?* Or, take a still further case, and one which might occur on any trial. Of the seven jurymen, suppose two were relieved by the judge during the trial on the ground of ill-health, then the majority of the five remaining would be only *three*, and this is a number no one would take. It is different from what I before said about an arbitration, because there, when a matter has been calmly discussed before able arbitrators, the opinion of three would be as good as that of twenty; but it is different when a case has been partly heard in court; the speeches of the learned counsel, the more or less of excitement which must always prevail, make the opinion of three or five very different. Again, if the two who went away were the two special jurors (if the composite scheme be adopted), would we feel safe in leaving our case in the hands of the three remaining common jurors?

All honour to the common jurors, for the honest way they do their work; but in many cases, where important commercial questions arise, how can a small tradesman, from a distant part of the town, possess the requisite knowledge to decide the point, or the necessary patient intelligence to disentangle the meshes in which the point is involved? In criminal cases the jury should be still twelve, and the vote should be unanimous. In civil cases the number should be still twelve, but the vote of nine should be taken. The great thing to arrive at is, that the stupid juryman can be out-voted, and prevented from delaying the rest, while the honest and independent juryman should be able to vote according to his conscience, without being crushed by the rest.

The majority vote would apply to both, of course; but I hope, for the credit of the British jury, it would be hard to find more than three impenetrable blockheads on any jury,

while the chance of finding honest and more or less intelligent men is very much greater.

The famous case of the Seven Bishops will of course be quoted against me; but, while honouring the independence of the sturdy juror who eventually brought the rest round to his views, I do not think that case is any argument against my proposition. The jury in that case were notoriously corrupt; some had made up their minds before they came into the box; and juries at that time were not so free as they are now. In those days, the experiment would not have been safe. Lord Campbell, some years ago, proposed to let the vote of *ten* decide, but this number seems to me not so good as nine. The judges then were all against him, and I believe many members of the bar are against the proposition now.

I have already drawn the paper out to a most unreasonable length, so will hasten to bring my remarks to a close.

The last chief point we have to consider is the qualification of jurors. At present the lists are made out very capriciously, gentlemen who are esquires, merchants, or bankers being reserved on the list of special and grand jurors. There are a great number of gentlemen in the town of Liverpool, who come under none of these heads, and yet are in every way most fully qualified to act. For instance, in the County of Lancaster, the evidence laid before Lord Enfield's Committee showed there were only *fourteen hundred and fifty* gentlemen on the list of special jurors, while there were only *forty-two thousand five hundred and fifty* common.

This is radically wrong. To suppose that in Lancashire there are only fourteen hundred and fifty gentlemen qualified as special jurors is such an insult to the wealth, intelligence, and population of this great county as to demand a rectification.

What is proposed is, to make the *rate book* the test of

qualification, and to form the lists solely on the ground of the rates paid; provisions being formed to admit that very large class of well-to-do men who live in lodgings. These are the main provisions of the bill. There are other minor points, such as permanent disability lists, for jurors who are disabled through ill-health; the age limit is raised to seventy, but persons of sixty-five can be let off serving if they shew good cause before the magistrates.

At present, as the existing law stands, no one is liable to serve more than once a year on a jury (except special jurors), unless all on the list have been summoned; and he is not liable to serve in more than one court on one day. There is a long list of exemptions to the Act; but I would remind those present that, to receive any benefit from an exemption, it must be claimed when the list is made up, afterwards it cannot be made available. There is a penalty in the Act for wrongfully inserting or omitting a name, but I am not aware whether it has ever, in the years the Act has been in force, been resorted to.

Yet, after all, it must be owned that the best and most effectual method to preserve and extend the trial by jury would be by endeavouring to remove all the defects, as well as to improve the advantages, incident to this mode of enquiry. If justice is not done to the entire satisfaction of the people in this method of deciding facts, in spite of all encomium and panegyric on trials at common law, they will resort in search of that justice to another tribunal, though more dilatory, though more expensive, though more arbitrary in its frame and constitution. If justice be not done to the Crown by the verdict of the jury, the necessities of the public revenue will call for the erection of summary tribunals.

The Attorney-General has deserved well of the country in endeavouring to eradicate the defects of the system, and to improve it if possible, or at any rate to bring it more

in harmony with the wants and requirements of the age resorted to.

And now, gentlemen, I must indeed conclude. I fear I have already tried your kind indulgence too long, and if I have done so can only regret to have trespassed on your time. However, at the risk of fatiguing you with what Sir John Coleridge calls the elegant optimism of Blackstone, I must just make one more quotation.

"Upon these accounts, the trial by jury ever has been, and I trust ever will be, looked upon as the glory of the English law. And if it has so great an advantage over others in regulating civil property, how much must that advantage be heightened when it is applied to criminal cases . . . It is the most transcendent privilege which any subject can enjoy, or wish for, that he cannot be affected either in his property, his liberty, or his person, but by the unanimous consent of twelve of his neighbours and equals. A constitution that I may venture to affirm, has, under Providence secured the just liberties of this nation for a long succession of ages."

NOTE ON THE TRACHEAL POUCH OF THE EMU.

Dromæus Novæ-hollandiæ.—VIELL.

BY MILLEN COUGHTREY, M. B.,

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IN a specimen of this creature which I had the opportunity of dissecting on the 8th of March last, through the courtesy of Mr. Moore, I found the tracheal pouch, which is a marked character of the emu, as distinguished from the other struthious birds.

The pouch has been well described by Dr. James Murie, of London, and other observers, an abstract of their work being embodied in Dr. Murie's own paper, which is printed in the *Proc. Zool. Soc. London*, for 1867, p. 405; so that I shall simply content myself with pointing out a few of the more important peculiarities of the present specimen.

The slit in the anterior part of the trachea is produced by the deficiency of ten rings in front.

But the lips of the slit present a peculiarity, the right having eleven cartilaginous elements, the left only ten. The extra, or eleventh, cartilaginous element of the right lip is due to a small bar of cartilage being interposed between the lower border of the right half of the uppermost incomplete ring (first incomplete ring), and the upper border of the right half of the incomplete ring, immediately below the previous one (second incomplete ring).*

In point of number of incomplete rings, the present specimen agrees with that described by Mr. Robert Anderson

* I am satisfied that the right half of the uppermost incomplete ring does not bifurcate.

in the *Naturalist*, 1856, in which the author states, "the opening extends along ten of the rings," but it differs from those mentioned by Fremery, Drs. Knox and Murie, as may be seen by the following table:—

* Murie's adult	♂,	6	rings	incomplete.
" "	♀,	5	"	"
" young	♂,	5	"	"
Fremery,	?,	9	"	"
Knox,	?,	13	"	"
Anderson,	?,	10	"	"
Coúghtrey,	?,	10	"	"

In Murie's adult ♂ bird the slit had seven cartilaginous elements in its right lip, six in its left: in his adult ♀ bird, six in its right lip, five in its left,—the excess in point of number in the right lip being due to a bifurcation of one of the rings.

It seems to me rather a curious coincidence, that in the present specimen the excess in number should also be in the right lip.

In the female adult bird, Murie figures, and describes, certain band-like duplications of the walls, which partially divide the cavity of the sac. In my specimen, these are wanting, and the sac is simple and undivided.

As regards the general form of the sac and its structure, it is similar to those described by Dr. Murie and others, except that there was no smaller pouch at its upper end.

The sác springs from the lips of the slit in the trachea, and its walls are continuous with the elastic bands of connective tissue intervening between the cartilaginous rings.†

* *Vide* loc. cit., p. 409.

† After Dr. Murie's criticisms on the figures and illustrations of other observers, I am sorry to have to record that his "figure 1" does not give a correct impression of the relation of the walls to the lips of the slit; it does not pourtray the continuity which subsists between the sac-walls and the lips of the slit in the trachea.

The walls are composed chiefly of white or areolar tissue, combined with much of the yellow or elastic variety.

Dr. Murie thinks it is homologous with the median air-sac of the chameleon, but in connection with this I would with deference remark, we must remember the pyriform sac of the chameleon is more a dilatation of the membrane existing between the first ring of the trachea and the posterior border of the united thyro-cricoid cartilage, and therefore can no more be regarded as a tracheal pouch than can the sacculated thyro-hyoid membrane in certain monkeys.

The specimen will be preserved in the Free Public Museum, Liverpool.

ON THE CAUSE OF EXPLOSIONS IN FLOUR MILLS; WITH ILLUSTRATIVE EXPERIMENTS.

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ABSTRACT.

WHEN gas issues into the air and is fired, it burns only where it meets the air; in ordinary cases the heat developed by the burning of any one portion of gas and air is sufficient to set fire to the next portion; and thus a continuous flame is kept up, which burns quietly so long as the supply of both ingredients is maintained.

If the air is mixed with the gas before it is fired, the combustion is more rapidly completed, and the flame spreads quickly through the whole; yet, unless the proportions are properly adjusted, the combustion is not explosive.

If the quantity of air mixed with the gas is such that its oxygen is just sufficient, and no more than sufficient, to effect the complete combustion of the constituents of the gas, then, on the application of a flame, it will spread almost instantaneously through the whole mass; all the heat of the combustion will be developed suddenly, producing great and sudden expansion of the products of combustion; producing, in short, an explosion.

If the quantity of air is greater than necessary, the excess will act in two ways; (1st) it will take up some of the heat produced by the combustion; and by lessening the temperature will lessen the expansion of the gases, and so diminish

the violence of the explosion; (2nd) it will act as a mechanical spring, like the buffer of a railway carriage, and thus again diminish the effect of the explosion.

The quantity of air may then be increased until its cooling effect will be so great, that the temperature produced by the burning of the first portion of gas will not be sufficient to set fire to the second portion; and the mixture will burn only when in direct contact with another flame.

One reason why gas explosions occur so readily, is that gas and air become easily and thoroughly mixed by natural diffusion; but an explosion may occur if a solid combustible is intimately mixed with oxygen in equivalent proportions.

Gunpowder is a fine mixture of the combustibles, sulphur and carbon, with an oxygen-bearing salt—nitrate of potash.

Explosions of mixtures of solids with air have hitherto been of rare occurrence, because solid bodies, by reason of their weight, are not apt to be mixed with air or gaseous oxygen. Nevertheless, one such case of an explosive mixture is in almost daily use, for the production of lightning in theatres. The resinous seeds, or rather spores, of the lycopodium plant, which are very small, light and dry, are readily mixed with, or diffused through, the air, by being blown through a tube, forming a dusty atmosphere, which, on coming in contact with a flame, explodes with a brilliant flash. Any dry dust of a combustible substance is capable of producing a similar effect in a greater or less degree. The fine dust of rice or flour, such as that which pervades the atmosphere of a flour mill, explodes like lycopodium when blown through a tube into a flame.

An explosion will not always occur when dust is diffused through the air of a flour mill; when gas escapes into the air it does not always explode.

A fire explosion consists in the sudden combustion of a mixture, whether solid, liquid, or gaseous, or partly in each

of these conditions, containing a combustible substance, and a supporter of combustion, such as oxygen, finely divided and intimately diffused throughout each other, and exactly or nearly in equivalent chemical proportions; and to inflame that mixture there must also be present a body hot enough to inflame the mixture, such as a flame or spark. The failure of any one of these conditions prevents the explosion; for example, if there be an excess or a deficiency of any of the ingredients of the explosive mixture, or if they be not thoroughly mingled, the contact of fire will either fail to inflame the mixture, or will produce only gradual combustion, and not explosion; or if the spark or other hot body be below the necessary temperature, the inflaming or combustion will fail. It thus appears that it is only through the coincidence of certain conditions that a fire explosion is possible; and this accounts for these being only of occasional and not daily occurrence in flour mills.

Every one knows that the atmosphere of flour mills is dusty; and we have seen that the dust is capable of exploding under certain circumstances. It remains to be explained how these circumstances are brought about. In large mills driven by steam-power, it is necessary to draw off the finer dust by means of an exhaust, in order to keep the air of the mill clear, and to raise the quality of the flour. This exhaust consists of a fan, which creates a strong current of air in a tube called the exhaust conduit, and sucks the finer portions of the dust from the grindstones into chambers prepared for its reception, called the exhaust-box and stive-room. The conduit and stive-room are constantly filled with an explosive mixture during the working of the mill; and the air of the mill in the neighbourhood of the grindstones is sometimes so filled with dust as to be explosive when a candle or lamp is introduced into it, or it might even be fired by a lighted tobacco pipe. In the better class of mills,

however, the stones are so thoroughly boxed in that there is little or no communication between the air of the room and the dusty atmosphere of the exhaust. A source of heat, sufficient to fire the exhaust conduits, may be produced by a piece of metal, such as a nail, getting between the mill-stones, and producing sparks, which consist of white hot globules of metal.

Another source of heat will be best explained by appending the following quotation from a report made by the late Professor Rankine and by Dr. Stevenson Macadam, detailing the causes of a destructive fire and explosion which occurred at Tradeston Flour Mills, Glasgow.

"1st. The primary cause of the fire and explosion was the accidental stoppage of the feed of one of the pair of stones engaged in the grinding of sharps, which led to the stones becoming highly heated and striking fire.

2nd. The fire thus generated inflamed the finely divided dust, which was diffused through the air in the exhaust conduits, and then passed on to the exhaust-box.

3rd. The sudden combustion of the dust diffused through the air, would produce a very high temperature in the gaseous products of that combustion, and this would necessarily be accompanied by a great and sudden increase of pressure and bulk, constituting, in fact, an explosion.

4th. The first effect of this explosion would be to burst the exhaust-box, and allow of the diffusion of the dust and flame throughout the atmosphere of the whole mill.

5th. This communication of inflammable dust and flame throughout the atmosphere of the whole mill was the cause of the second explosion, by which the gable walls were blown out, the mill reduced to ruins, and the woodwork set on fire.

6th. The stores or granaries were set fire to partly by the flame and fire from the mill travelling along the gang-

ways, and partly from the burning materials falling through the skylights.

7th. No explosive or other foreign material was used in the manufacture of the flour, and we found the steam-boilers uninjured.

8th. We have not been able to trace blame on the part of the proprietors of the mill, or of any one in their employment, as every precaution known at the time was used."

The following precautions are recommended :—

"1. All receptacles of the dust, such as exhaust-boxes, stive-rooms, smut-rooms and exhaust-fans, should be placed outside the mill, in buildings so constructed as to be readily blown to pieces, in order that any explosion which may take place in them may easily find vent, and not be forced to travel back into the mill.

2. The roan or conduit leading from the mill to the fans should be of small size, and might perhaps have a swing door, opening outwards, placed in the exhaust-box before the fan. There is, however, a practical limit to the diminution of the diameter of the conduit.

3. Metal conduits are better than wooden ones, inasmuch as they conduct away heat, and reduce the temperature of the flame; but in ordinary weather they condense moisture, and lead to the formation of paste with the flour dust: this causes an inconvenient obstruction.

4. There should be no other direct communication between the mill and the exhaust-box and stive-room, than the exhaust-roan or conduit.

5. The use of naked lights should be prohibited.

6. The use of magnets in the feed spouts, to collect nails and other pieces of iron which might fall into the hoppers, should be made universal."

THE EXPLORATION OF MOAB.

By R. C. JOHNSON.

THE discovery in the year 1868 of that most valuable inscribed monolith, known as "the Moabite Stone," was the means of directing the attention of archæologists and geographers to the unexplored parts on the east side of the Dead Sea.

The British Association, in the years 1870 and 1871, voted a small sum (to which also a contribution was added from the funds of this Society), to a committee, of which the Rev. Canon Tristram and Dr. Ginsburg were the active members, "for the survey and further exploration of the Country of Moab."

They arranged to be accompanied by Mr. Klein, the London Church Missionary Society's Agent at Jerusalem, who is known to fame as the discoverer of the "Moabite Stone."

Mr. Klein, on account of his perfect acquaintance with Arabic, and Arab manners and customs, was of essential service to the expedition, and his presence greatly facilitated our subsequent progress through the savage tribes of the Safieh, and our escape from "that notorious ruffian" the Mudjelli of Kerak.

The other members of the party were Messrs. W. Amherst Hayne and Mowbray Trotter, who were respectively engaged in the departments of Botany and Ornithology, while Mr. C. L. Buxton and myself were chiefly occupied with the Camera.

The Map which accompanies this paper was made from

angular observations, mostly taken by Dr. Tristram and myself, with the prismatic compass or a pocket sextant.

No absolute determination of positions was attempted, chiefly for want of sufficient time in which to make the requisite observations, but also because we found that Jerusalem, Hebron, Ain-Jidy, Jericho, and other places, of which the positions are known, were so frequently visible from the elevations from which almost every observation was made.

On the morning of the 30th January, 1872, the expedition (which consisted of seven Europeans, about fifteen natives, with twenty-five horses and mules) left Jerusalem for Hebron, where, after camping two nights, the terms of our escort to Kerak were settled. The escort made an addition to the party of twenty men, of the Jehalin tribe of Bedouin. Two wet days of uncomfortable travelling through the dreary solitudes of the Wilderness of Judea, brought us to the passage of the formidable cliff of Ziz, at the foot of which lies the oasis of Ain-Jidy. Here, at a depth below the level of the sea of thirteen hundred feet, the climate was suddenly transformed to a summer temperature. On the next day, the 4th February, at Sebbeh, about ten miles south of Ain-Jidy, at eleven o'clock a.m., the thermometer stood at 80° Fahrenheit inside the tents. Sebbeh is the ancient Masada; it is famed for having been one of the last of the Jewish cities to yield to the Romans, and for the heroic resistance which its inhabitants offered to the invaders.

While here we had a proof of the great distance at which occasionally the human voice can be heard. Sebbeh is twelve hundred feet above the place at which we were camped; it was a very hot day, and Klein and Hayne stayed at the foot of the precipice, where the horses were left in the ruins of a Roman encampment, the vertical

distance which separated us was eleven hundred feet, I should estimate the actual distance between us at fully half-a-mile. We tried, merely for a joke, to attract Klein's attention by shouting. This was easily done; and then, seeing Hayne leaving the place as if to come to us, we called to him to go back, and to our surprise distinctly heard his reply, "No, I am coming up." He was then considerably further from us than at first, having had to go about a quarter of a mile in an opposite direction before he could attack the ascent.

This circumstance affords evidence in favour of the New Testament accounts of multitudes listening to such an address as the Sermon delivered from the mount.

We were often astonished at the brilliancy of the zodiacal light, which was visible every evening at the beginning of our tour; and it was on going out of the tent to observe it, while here, that we beheld that magnificent aurora borealis which occurred on the night of Sunday, 4th February. It commenced about seven o'clock, and reached its greatest splendour at about nine o'clock, when it presented a well defined coronal form, that extended in azimuth from N.E. to N.W. nearly 90°, and reached an altitude of 28°, passing close to the Pole star. Its colour was reddish, no green, nor were there any flashes of lambent light.

We were surprised to see with how little wonder or even attention the Arabs regarded it, considering the rarity of such a phenomenon in latitudes so far south as 30°. Some of them had seen it once, but many of them had never seen it at all before this occasion.

We proceeded along the shore of the Dead Sea to Zuweirah, and under the edge of Jebel-Usdum, the extraordinary salt mountain. It is several hundred feet high, about seven miles long, and one and a half wide at the base. While passing it, we were driven by a thunderstorm to shelter in a

large cave in the mountain; and after it had rained heavily for nearly an hour, there suddenly was heard in the darkness, a rushing sound, and a stream burst forth and ran in a well-worn channel out to the shore, which on tasting we found to be a strong saline syrup. We chipped the side of the cavern, which is literally solid salt, and on going out noticed that the rain had washed away the efflorescence from the exterior of the mountain, in many places exposing large surfaces of rock salt.

We then entered upon the passage of the swampy Sebkha, which we crossed at about four miles from the south end of the Dead Sea, and approached the Safieh, our Sheikh Selameh being keenly on the alert for signs of Arabs.

The Safieh is a fertile stretch of land, about ten miles long, and three or four wide, the vegetation being very similar to that of the oasis at Ain-Jidy. It has a well defined boundary on the Dead Sea side, which consisted here of clumps of shrubs. From behind these, the Arabs, who had been doubtless watching our approach for some hours — themselves invisible to us— suddenly debouched, and in their own demonstrative fashion, by firing of guns, and waving of spears, and brandishing clubs in the air, quickly assumed a warlike attitude.

Sheikh Selameh and our dragoman, having had a roll in the muddy stream which separated us, the latter also having his pockets and saddlebags rifled in the process of crossing, went over to arrange terms, and while this was being done, we were occupied in preventing the thirsty mules from rushing into the water. Matters were quickly settled between the Sheikhs, but not soon enough to prevent a free fight, on a small scale, between our guard and the other Bedouin, in which one of our men fared rather badly.

We could not for a long time find out from these Arabs to what tribes they belonged; they proved to be Beni-Atiyeh,

the wildest and most dreaded of the Edomite Bedouins, and Ghawarhineh, some of another smaller tribe. We had agreed to pay Sheikh Selameh an extra bakshîsh, if Beni-Atiyeh were met with, on account of the bad character they bore: Here we began to realise our first disappointment, and that on the very threshold of the undertaking, for we had all looked forward with the keenest expectation to this as a sort of garden of Eden, where many rare plants would be added to the collection of the botanist, and where bulbuls, sunbirds, &c., would be bagged by the ornithologists.

Dr. Tristram had been compelled to hasten from this very spot on a former visit to the country, having found it the scene of a ghastly tragedy. We had a very unpleasant time for a day and a half, during which we visited the ruins of Busariyeh, about three miles from our camp. It is difficult to assign any date to the largest ruins, but there are more recent smaller ones of water mills, that were perhaps used for making sugar.

We did not attempt to photograph here, the people were so troublesome, invading our camp, and even the tents, so that we had to keep a sharp eye upon all our valuables.

We departed from the Safieh under the escort of the son of the Mudjelli of Kerak, with twenty men, having paid off Sheikh Selameh, and the Jehalîn men.

Our change of circumstance was scarcely an improvement, for although we did not so much dread actual violence on the part of the Kerak Arabs, as from the more brutal Beni-Atiyeh, yet the slightly more civilised, but astuter knavery of the Sheikhs of Kerak, was quite as great a hindrance to our progress.

We passed hastily out of the Safieh northwards, through the utter ruins of Nemeirah, up a steep and at first very barren gorge to Dra'a, where we camped. The neighbourhood of Dra'a is fertilised by a small stream that runs

through a deep Wady, in which we found date palms and oleanders. Dra'a is one of those places which some suppose to be the site of the ancient Zoar.

After a stormy night, enlivened by a fight between two Sheiks with sticks, about the price of a lamb which one had concealed from the other, and our first experience of attempted horse stealing, we essayed an early start; when, just as we were ready, a demand was made for £70, in order, it was alleged, to pay off some of our guard who were not going the whole way to Kerak. Upon our protesting, the Sheikh drew his sword, and said that not a mule should stir till it was paid. We succeeded in reducing the amount to £20, which we were compelled to pay.

The first part of the day's journey was through a rugged pass, in which the geological formations were very interesting. The dip of the strata, which consisted of mountain limestone and red sandstone, towards the Dead Sea, was here at its largest angle, about 60°, and for the first time we met with an outcrop of basalt. As we proceeded, the inclination gradually became less, and the gorge opened out into a wide valley that ran all the way to Kerak.

The position of Kerak is very curious. It was visible for two and a half hours before we reached it, and is situated on a hill about one thousand feet high, detached from the surrounding higher mountains on all sides but one, and before the invention of gunpowder must have been almost impregnable.

The easiest access to it is by a very steep stone-strewn path, along a series of zig-zags, which terminate at the entrance to a crooked tunnel of about sixty yards in length.

The fortifications on the south and east sides are the most formidable. The dates of construction are various; some parts, probably, being Saracenic, and a great deal Crusading. On the walls of the Tower of Bybars, in which

we pitched our camp, there are two lions of the Crusading type, quite as perfect as, and similar to, those in the wall of Jerusalem at the Stephen gate.

Kerak is the only inhabited city in this part of the East side of the Dead Sea. The houses are nearly all underground, and sometimes we walked and even rode upon their roofs without being aware that they were dwelling places. The population is variously estimated at from two thousand to eight thousand, of which two-thirds are said to be Moslems, and the remainder Greek Christians.

In one house, the remains of a Roman bath are visible, and also some marble tesselated pavement. In another part is a curious door-way; the lintel has some Christian emblems carved upon it and a modern Arabic inscription, and it is all set within a complete Saracenic niche. We were shown several stones with Greek and Arabic inscriptions upon them.

We knew pretty well the character of the Mudjelli of Kerak before we went there, but we thought that, as we had credentials from the foreign office to the Turkish authorities, to whom this man is subject, he would have been amenable to that authority. We soon found out our mistake; for, immediately upon our arrival, the Mudjelli came down to our tents, and was not slow in informing us that he would be delighted to protect us while we remained in his country for the modest sum of £700. Nearly the whole of the time we were in Kerak was occupied in negociating with the Mudjelli for the reduction of this sum; and as soon as that was settled, we thought it best to leave, so that we only spent four days at this interesting place, which we had hoped to have been able to make the centre of many excursions. During the greater part of this time we were prisoners in our tents, and had only one full day for work. The party was divided. Tristram, Ginsburg, Klein, and

Trotter took a long ride outside the walls, in which a number of ruins were visited, and their places roughly ascertained (see map); while Buxton and Hayne stayed with me inside the town, and made a ground plan of the fortifications, and photographed. We were followed by a number of the curious inhabitants, to whom we were a great source of amusement, and who would have prevented us from obtaining a single photograph had we not feed two of the Mudjelli's relations to keep them at a respectable distance.

We were apprehensive of further detention, on account of the large sum which the Mudjelli demanded, and had sent a messenger to Jerusalem to acquaint the British Consul with the circumstances. While he was away, we had several angry disputations, which resulted in the amount being gradually reduced, when, by the good offices of Sheikh Żadam (a son of Effendi Faiz; who had arrived straight from Jerusalem, where he had signed a contract to escort us for fifty days for fifty napoleons in the country of the Beni-Sakkers, their tributaries), we at last prevailed on the Mud-jelli to let us go upon our giving him a further sum, which made the total about £70 sterling — exactly one-tenth of his original demand.

From the walls of the Tower of Bybars we had, on Sunday afternoon, an example of the splendid clearness and steadiness of the air, for which we often noticed the table land of Moab to be remarkable.

We could see Jerusalem distinctly with the naked eye, a direct distance of fifty miles; and when a very good two-inch achromatic telescope, made by Cooke, was brought to bear upon it, we could easily make out its prominent buildings, such as the Mosque of Omar, Tower of Hippicus, &c., as well as the buildings on the Mount of Olives.

The departure from Kerak took place at an inauspicious moment; for before we had passed through the town, a terrific

storm of rain and wind met us, against which we could not force the horses, so we had to beat a retreat, and shelter under the Greek Church.

After descending a thousand feet to the valley, and re-ascending about twelve to thirteen hundred feet, we struck the remains of the Roman road, which was followed until we reached the Wady Mojib.

The remainder of the day's journey was altogether upon the summit of the plateau, and we were frequently enveloped in driving mists, and were not able to see far. We reached the dry reservoir at Rabba, in which, on account of the high wind, we camped, in a very uncomfortable state.

There are some very interesting ruins here; but, although we stayed a day for the purpose, all attempts to photograph them failed, owing to the unfortunate weather.

While we were here, Mr. Klein received the melancholy news of the serious illness of two of his sons. He returned immediately, but did not reach Jerusalem in time to see them alive. Mrs. Klein's letter was captured by one of the Mudjelli's sons, who illtreated the messenger, thinking that he was the man whom we had sent to the Consul, and we had to pay a napoleon to obtain possession of the letter.

As our route lay close to Jebel Shihan, we had only to make a slight detour in order to ascend it, and from the summit obtained angles to Jerusalem, Ain-Jidy, and several other places.

Jebel Shihan, the highest point we ascended in Moab, is about three thousand seven hundred feet above the level of the sea, or five thousand feet above the Dead Sea. It commands an extensive prospect, although not so fine as that from several other elevations in the country. At one o'clock, we arrived at the edge of the stupendous gorge of the Wady Mojib, the Arnon of the Bible.

The descent of two thousand two hundred feet is exces-

sively steep in many parts, and was very arduous for the beasts of burden ; it occupied nearly three hours to reach the stream, and it was not till near five o'clock p.m. that the last mule had commenced the ascent of two thousand feet on the other side. At half-past eight o'clock we reached the summit, after an exhausting day of twelve hours. Our tempers were not improved by a further delay of three hours for dinner, which was not commenced until the ultra-aristocratic hour of eleven p.m.

On the following morning, Mr. Klein, to the great regret of every member of the party, left us to pursue the shortest possible journey to Jerusalem.

Dr. Ginsburg also returned with him, doubtless believing that the annoyances experienced so far from the various tribes we had passed through would continue to the end, and preclude the accomplishment of any satisfactory results by the expedition.

We were now quite out of the domain of the Mudjelli and his minions; and from this day, for upwards of a month, under the escort of Sheikh Zadam, or one of his brothers, without any armed guard, our small party of five rambled through the Northern part of Moab without fear of molestation.

Nothing can show more clearly than this the authority which the Beni-Sakkers possess in the country, and the necessity of travellers making terms with them, instead of the Beni-Hamideh, or any of the smaller tribes.

From Aroer we passed through Dhibân (*Dibon*), the site where the celebrated Moabite Stone was first seen by Mr. Klein, on the 19th of August, 1868. After staying about two hours, we turned at right angles, and, passing Rujum Selim, came to Um Rasas, which was our head quarters for a week. This place is the furthest East that has been previously visited, and that only once before, by Messrs.

Palmer and Drake, who, under the protection of the Beni-Hamideh, could not stay there even for a day.

At Um Rasas, the ruins are very extensive; they consist of a part within walls about a hundred and eighty yards by a hundred and forty yards, and of a much larger part outside. There are the remains of several Christian Churches, and of Greek architecture; also of an amphitheatre, of which the interior is only indicated by the shape of the ground. A mile from Um Rasas is a remarkable mortuary tower, about sixty feet high. A legend is connected with it, and some Arabs said that they saw two of our party fly to the top, and they came to the camp to enquire whether we had found any of the treasure which is supposed to be there.*

After having been here a couple of days, news arrived that an army (which we found to consist of about two hundred cavalry, and a few brass guns), with the Pacha of Nablous at its head, was on its way to deliver us from captivity at Kerak. Mr. Moore had sent with it M. Salami (his courteous deputy), who brought with him £600 for ransom money.

Dr. Tristram, accompanied by Trotter, immediately set off to their camp, a two days' journey, to thank the commander, and prevent him from incurring further expense and trouble on our account.

We were also detained here in the expectation of having an inscribed stone brought to us by a Bedouin, who said it belonged to him, and that, for fear of its being stolen, it was buried in the vicinity; but notwithstanding many promises,

* The principal articles of diet all the time of our nomad life were lamb or kid, and the Greek partridge (*Caccabis Saxatilis*). We sometimes found the elegant little Heys partridge (*Ammoperdix Heyi*), but nearly everywhere the Greek bird (almost twice the size of the English) is common. We always shot most game in the ruins, as there is very little cover afforded on the plains. At Um Rasas, the birds were exceedingly plentiful during the whole time of our stay in the neighbourhood.

and the evident desire of the man to show it to us, we had to leave without seeing it.

We found the Arabs everywhere on the *qui vive* about inscribed stones, and we were several times led out of our way to inspect some worthless specimen of carved limestone.

Khan-zi-bib, the most easterly place we visited, also for the first time, is about twelve miles distant from Um Rasas. We found that we did not cross the Derb-el-Hadj, or pilgrim road to Mecca (which on all the maps is marked as running by Um Rasas), until we were within a quarter of a mile of this curious old Khan.

The road to it lay at first over an undulating plain, which, at about half way from Um Rasas, became perfectly flat and extended to Khan-zi-bib, close behind which the hills begin to rise, and attain an elevation apparently of about five hundred to six hundred feet. A few miles from the Khan we startled a large herd of gazelles, which must have numbered two or three hundred.

The Khan has high walls, which seem to be of modern construction, and are strengthened with circular buttresses on the exterior; the large stones are all rough, and the interstices are filled with small ones, and it has been plastered over. Some large stones, forming the lintels of gateways, very rudely carved, formed the most peculiar feature of this place.*

From Um Rasas we passed a few uninteresting ruins to Remail, where our camp was pitched on the bank of the Wady Themed, in which (as was frequently elsewhere the case) no water was perceptible till a hole was dug three or four feet deep.

From this place Kherbet Zafaran was visited; and two

* Sheikh-Zadam informed us that five days journey east of Khan-zi-bib are the remains of magnificent ruined cities, which no Europeans have visited; they are said to be in a state of good preservation, and all built of black stone (basalt), and that there are huge stone doors still swinging on their hinges.

good series of angles were taken, both with sextant and prismatic compass. Then Kherbet-el-Heri, close to which is Kasr-el-Heri; all the castles or forts about here are of exactly the same type, which is the rudest possible, and are in a similarly dilapidated state.

At Um el Weleed the ruins are both extensive and interesting. A square building, in a tolerable state of preservation, and a court yard, forty yards by twenty, paved with square flags, and remains apparently of Greek carving, are some of the most important. Unfortunately, on account of the weather, all the photographs taken here excepting two were failures. My camera was blown down (and so broken that it required half a day to repair it) when the second plate was being exposed.

In this neighbourhood we found the existing maps to be not only very deficient in names of places, but also erroneous. At Um el Kuseir there is a small building which was constructed of very large stones.

Ziza was reached in two hours from Um el Kuseir, and was our head-quarters for four days. The most important work at Ziza is a fine reservoir, which is built of massive blocks of stone, and is a hundred and forty yards, by a hundred and ten yards, and six yards deep, and still holds water, although the sluices and dams, of which the remains are quite distinct, are almost altogether useless. The sluices are perfect, except the sliding doors, for which the grooves are cut; they are passages ten feet long, five feet high and two and a half feet wide, and there are three of them. Many stone troughs lie round the edges. Close to the reservoir is a fort of two storeys, in a good state of preservation. There is also a Byzantine building, in which is a niche or shrine, with many of the stones inscribed. On one of these some words from the Koran have been deciphered at the British Museum. Several specimens of the sand-grouse (*Sene-*

galensis) were shot here by Trotter, and we also saw the still rarer lanner, or Sakker falcon.

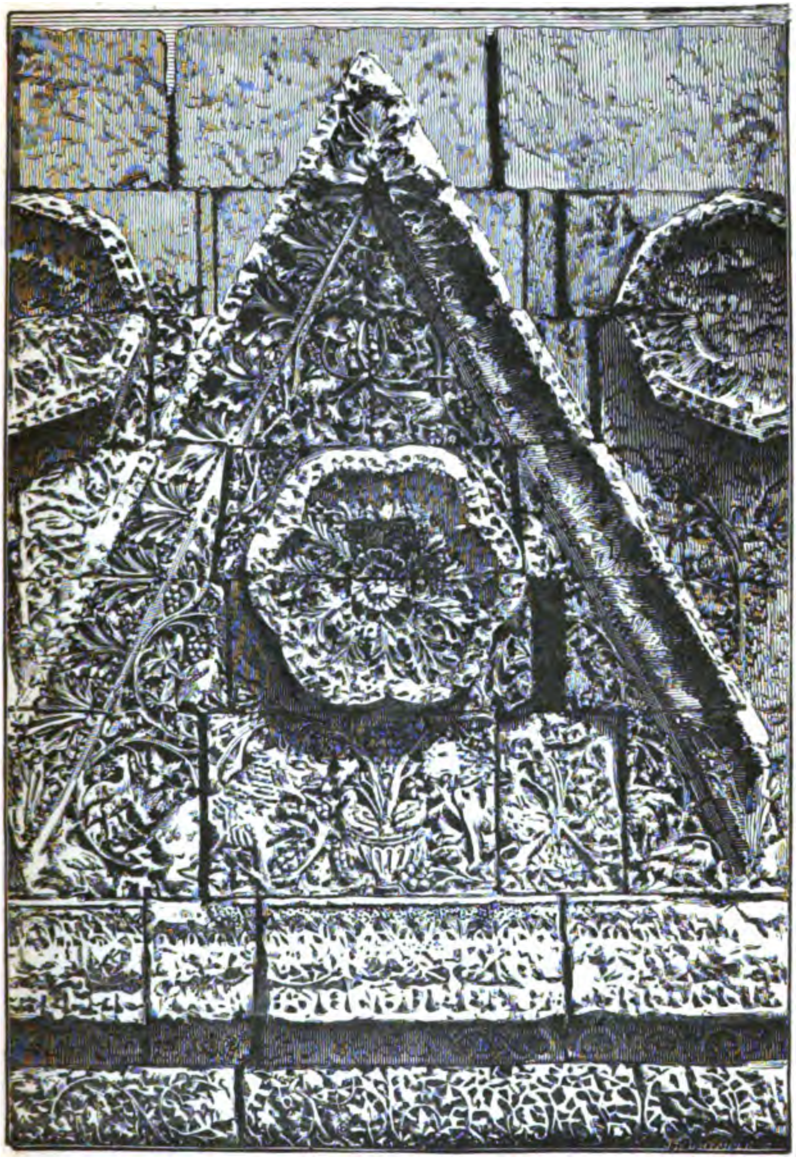
From Ziza, at a distance of about seven or eight miles, we could make out with our glasses a small ruin, which Sheikh Zadam said was insignificant. (The Arab idea of grandeur in a ruin is altogether connected with its size; and we had the most extravagant description given of Attarus, which is large, but in which there is scarcely one stone standing upon another).

But although a place of small extent, being contained by a wall of a hundred and seventy yards square, we found Mashita of extreme interest, for it had no resemblance to anything else that we saw in the country. The exterior wall is entirely built of smooth square-cut stones, and is of the same pattern all round, excepting for about seventy yards in the centre of the front; this part is about twenty feet high, and is covered all over with most exquisite carving, in which, in a sort of Arabesque pattern, animals, birds, fruits and flowers are most ingeniously intermingled. (See Plate.)

Behind this façade there are, just level with the surface of the ground, the foundation stones of a large building, of which this splendid piece of work was intended to be the front.

At the opposite end of the enclosure, against the wall, there is a large building in an unfinished state, constructed of bricks ten inches square by two and a half inches thick; the method of construction and the solidity of the work reminded us forcibly of such ruins as the Baths of Caracalla in Rome. Mr. James Fergusson* considers it to be the work of Chosroes II., of the Sassanian dynasty, and the date about A.D. 614.

* Mr. Fergusson's opinions of the history of Mashita are fully stated in a chapter which he has written for Dr. Tristram, in the *Land of Moab*, where there is a drawing of an elaborate restoration of this façade.



FROM A PHOTO. BY R. C. JOHNSON. SCALE ½ INCH = 1 FOOT.

FAÇADE OF WALL AT MASHITA,

SHOWING ONE FACE OF THE BUTTRESS ON THE WEST SIDE OF ENTRANCE.

We returned to Ziza, and on the next day passed through El Kustul, starting a large grey wolf out of the ruins on our approach. A building, having a high flat wall, which terminated with a circular projection ornamented with Corinthian pilasters, was the best preserved. Inside we saw two marble capitals, very much weather worn.

Then to Jilūl, which was one of the most valuable points from which bearings were taken; it commanded a most extensive view.

On arriving at our camping ground at the Wady Habis, we found we were honoured by a visit from Effendi-y-Faiz (the father of Sheikh Zadam), accompanied by his elder son Zottam, and a younger one Sahan, whom we had seen before, and several other lesser notabilities, who were awaiting our arrival.

Next day we entered the territory of the Beni-Hamideh, and passed a number of places of minor interest on the journey down to a delightful camping ground on the upper part of the Zerka-Ma'in; but this was improved upon when, after a splendid ride through this valley,—which, as we descended it, became too rough to go along the bottom, so that for some miles the top of the gorge had to be taken,—we dropped down a rugged declivity of a thousand feet, upon the hot springs of the Callirrhoë. We remained here for a week; it was the finest camping place we had, the only two draw-backs being that the water tasted slightly of sulphur, and that the precipice, which was scarcely surpassed in steepness by the Cliff of Ziz, had to be mounted before we could start on any distant excursion.

It was a most agreeable change of temperature to record a minimum at night of 60° Fahr., when a few days before, at Ziza, we had had 8° of frost. The hot springs in the Callirrhoë have been previously visited. They are sulphur springs, which rise always near the junction of the red or

yellow sandstone and limestone; there are also in the valley many basaltic outcrops, which take the well known pentagonal columnar form. The finest specimen is an almost perpendicular crag, which rises sheer nearly two thousand feet. The temperature of the springs is, at the source, 135° Fahr., and, after joining the not inconsiderable stream of the Zerka Ma'in, their volume is sufficient to make the temperature of the whole over 100°; a small lake near to them is nearly 115°; and where the stream falls into the Dead Sea, some ten miles lower down, the temperature is still 90°.

From here we made an excursion to Makaur, which agrees etymologically and topographically with Machæros, known to readers of Josephus as the place which he identifies as having been the prison and scene of execution of John the Baptist. The ruins are as complete as they are extensive; but at the summit of the hill we found some remains that answer to the description of Josephus. This place had not previously been visited.

Another excursion was made to Zara, which we found quite on the shore of the Dead Sea. This was a long and very hot day's journey, occupying from half-past six a.m. till half-past six p.m., and was nearly all on foot, owing to the inaccessibility of the greater part of the route to quadrupeds. The piece from the entrance of the gorge of the Zerka-Ma'in to the Callirrhoë, though not more than six miles in a straight line, took us more than four-and-a-half hours. Many inaccessible corners were passed, by wading through the hot water; but we were compelled to scale the rocks (some eight hundred to a thousand feet high), by the Sheikh asserting that the stream was impassable higher up on account of a *jebel moia* (a mountain of water), a phrase which for a time puzzled us, till we at length perceived that he was describing a waterfall.

We departed from the Callirrhoë with reluctance; it had

afforded to each of us, according to taste, ample store for research and amusement. To the collectors of flora and fauna, and to the geologist, it was a perfect paradise, while the beauty and variety of its scenery overtaxed the powers of the photographers.

Attarus and Jebel Attarus were visited on the day we returned to the spot at which we had previously camped in the upper Zerka-Ma'in.

The ruins of Attarus (*Ataroth*) are very similar to those at Makaur. It is nearly as high as Jebel Attarus, and affords a finer prospect.

Jebel Attarus is the third highest summit we measured on Moab. It is about eight hundred feet lower than Jebel Shihan, or about three thousand feet above the sea. Close to the top the almond and butm trees were in full bloom, and on the summit is a very conspicuous terebinth tree, close to the ruin of the castle.

Ma'on, which is supposed to be the Beth-Baal-Meon of the Bible, consists of a rambling series of ruins on the hill tops. A few hours' stay did not lead to the discovery of anything of peculiar interest.

At Medeba the camp was pitched for several days. A disused reservoir, not quite so large as that at Ziza, and apparently of later date; the remains of circular buildings, that were probably temples, constructed sometimes of short pillars touching each other; and two columns of about twenty feet in height, the capitals being spanned by a roughly chiselled slab, standing unconnected with any thing by which a clue to their history or design could be ascertained, formed the most conspicuous features of these extensive ruins.

From Medeba, excursions were made to Muslibiyeh, Um Heiyat, and Ziara,* on the edge of the tableland; and

* I must again refer to the *Land of Moab*, where the identity of Ziara with the ancient Zoar is fully discussed.

for a considerable distance the summit of the ridge was examined for the identification of the site of Mount Nebo.

Dr. Tristram had, on a previous visit, concluded that one of the projecting spurs in this neighbourhood must be the place; and we certainly found a view which coincides with the description given in Deuteronomy (xxxiv. 1–3), for from it "all the land of Gilead unto Dan, and all Naphtali, and the land of Ephraim, and Manasseh, and all the land of Judah, unto the utmost sea, and the south, and the plain of the valley of Jericho, the city of palm trees, unto Zoar," were plainly visible.

We kept along the ridge for some distance, and then descended to the stream which takes its rise at Ain Mousa (*Moses' fountain*); it makes two pretty falls, one of which is over a cavern, full of maiden-hair spleenwort ; many of the fronds depending from the roof were from two to three feet long.

We then proceeded to Hesban (*Heshbon*); from its heights the tents of several tribes of Arabs were visible, the Adwan, Ajermeh and Beni Sakker being the principal.

From Hesban we went down the Wady of the same name, and pitched our tents next night in the centre of the Seisaban, a large plain, in many respects similar to the Safieh. We met some of the Beni-Atiyeh, who had behaved so badly to us at the other end of the Dead Sea; but as we were under the powerful protection of Sheikh Zadam, they were not able to annoy us.

By making an early start we hoped to be able in one day to go along the shore of the Dead Sea to the Zerka-Ma'in; but after a grand but difficult ride to a point within about three miles of it, we were obliged to return for want of time, having already run it so close that we were almost overtaken by the sudden nightfall which occurs in these latitudes.

The day had been hot and sultry, and at night the fitful

sirocco, which at intervals had been whirling the sand about the desert, increased to a gale, and burst upon us in heavy squalls; and on the last night in Moab we met with the first serious disaster to our camp, when at midnight one of the tents was carried away, Buxton, who had not retired, being involved in the wreck, while I remained asleep on the plain.

On the next day we crossed the Jordan at the newly-established ferry, and after spending part of a day in the oasis at Jericho, when, for the first time since our departure from Jerusalem, we saw at some distance the white tents of Europeans, we returned to that city on the following afternoon, after an absence of seven weeks and four days.

I regret to have to record already the loss of one of my companions in this journey. William Amherst Hayne, B.A., Scholar of Trinity College, Cambridge, was attacked by typhoid fever while travelling in Italy. He died at Catania, on the 5th of February, 1873.

NOTE ON THE HEART OF THE *DROMÆUS NOVÆ HOLLANDIÆ*, WITH REMARKS ON THE HOMOLOGICAL RELATIONS OF THE VALVES OF THE PRE-CAVÆ.

BY MILLEN COUGHTREY, M.B.,

DEMONSTRATOR OF ANATOMY, LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

THE viscus was obtained from the same emu whose tracheal pouch I described at last meeting.

In general anatomical characters, it agrees very closely with the admirable description given by Professor Owen in his *Anatomy of Vertebrates*.*

But as in the present specimen there is a well marked valve guarding the opening of the right pre-caval vein into the sinus venosus, I have been obliged to go more minutely into details regarding the right auricle than Professor Owen has done.

In the heart of the emu there is a right auricle, distinctly sub-divided into two cavities. The one is for the reception of the venous blood from the system generally, and the walls of the heart specially, by means of the large caval veins; and this cavity is commonly known as the 'sinus venosus.' The other is for the expulsion of the blood through the auriculo-ventricular orifice into the cavity of the ventricle; and this is best known as 'the cavity of the auricle proper.'

Both of these cavities, the 'sinus venosus' and the 'cavity of auricle proper,' are separated from one another by a valve, composed of two musculo-membranous folds, which Professor Owen has carefully described as the 'first' and 'second' semi-

* Vol. ii., p. 186, fig. 90. Also, *Cyclop. Anat. et Physiology*, Todd's, article "Aves," vol i., p. 580.

lunar valves. (*Vide loc. cit.*) Instead of using the terms 'first,' and 'second semilunar valves' in this Paper, I shall employ (as being more appropriate) the terms *superior*, and *inferior* fold, respectively.

Each of these *folds*, or 'valves,' has two faces, one looking towards the interior of the sinus, and the other facing the cavity of the auricle when the valve is closed, and these faces may be called respectively *caval* and *auricular*.

The anterior fold is much more membranous and free than the posterior one is.

At the opening of the right pre-caval vein into the cavity of the sinus venosus, there is a distinct valve, semilunar in shape and membranous in structure, being evidently formed by a duplicature of the lining membrane (endocardium) of the heart, having a few muscular fibres distributed within it.

It has two surfaces and two borders. The anterior surface is concave, and looks towards the lumen of the right pre-cava. The posterior surface faces the cavity of the sinus, and is convex.

The borders are respectively free and attached. The free one is concave, thin, and membranous. The attached one is convex, and thick, owing to muscular fibres entering it at this point. It is attached respectively to the right and upper walls of the 'sinus venosus,' and to the caval surface of the upper fold guarding the opening from the sinus into the auricle.

The right horn of this valve is just connected, and continuous with the caval face of the inferior fold (second semilunar valve), the left horn running right across, and being connected with the caval face of the superior fold, at a plane three lines below the end of the anterior crus of latter.

Attention has lately been drawn to the presence of valves at the orifice of pre-caval veins by Mr. Turner, Dr. Handyside,

and Dr. Morrison Watson. Before the cases observed by these gentlemen were published, very little was known on the subject. As regards the emu, this is the first time that such a valve has been recorded.

In man, the superior cava is generally devoid of valves at its orifice, but there are some exceptions to this rule. Thus, Professor Turner * described a case in which he found a valve guarding "the anterior and inner border of the auricular orifice of the superior vena cava." After this, Dr. Handyside, † of Edinburgh, observed it in two cases. In one case, an adult heart possessed "a valve (quarter inch broad by quarter inch deep) formed of endocardium, with an intervening lamina of striped muscle." It "lay within and parallel to the posterior segment of the rim of the superior cava." In the other case, a male fœtus of six and a half months, Dr. H. found "a complete semilunar valve, situated at the termination of the upper vena cava, its convex border being attached to the anterior and right wall of the vein, its concave free border projecting into the auricle."

Sometimes I have observed in the heart of man extremely well marked ridges at the entrance of the superior vena cava. These were caused by hypertrophy of the muscular bands which are normally disposed around it, one band being found at the left and anterior margin of the orifice of the superior cava, the other, at the right and posterior margin.

In the elephant, a valve has been observed by several writers, but its position is very uncertain.

Thus Vulpian and Philipeaux describe a valve they found in the heart of an elephant they had the opportunity of dissecting: — "Dans sa moitié interne, cet orifice est entouré d' un repli valvulaire qui paraît formé de deux parties, parce

* *Proc. Roy. Soc., Edin.*, 1868–69, p. 455.

† *Ibid.*, p. 501.

que, vers son milieu, il est épais et peu saillant. Ce repli naît de la partie antérieure de l'orifice de la veine cave postérieure, à une petite distance du point où naît le repli que nous avons déjà décrit. Son extrémité mince et effilée pénètre même á un ou deux centimètres dans la veine cave au delà de son orifice; il part de là en suivant la circonférence interne de la veine cave inférieure, dont il s'éloigne en suite pour gagner, par un trajet courbe, le bord interne de la veine cave antérieure, dont il entoure *la demi-circonférence interne et inférieure*. La figure de ce repli est celle d'un S couché, tordu sur lui même, de telle sorte que la branche appartenant à la veine cave posterieure soit dans un plan horizontal, et celle appartenant à la veine cave antérieure dans un plan vertical. Ce repli est très peu saillant au niveau de la veine cave postérieure; il devient assez saillant quand il atteint le bord de l'orifice de la cave antérieure." *

Dr. Morrison Watson † describes that seen by him in the Indian elephant, as "Taking its rise from the inner aspect of the opening, it wound round the upper margin, and finally passing backward became attached to the outer wall of the auricle, close to the point of entrance of the posterior cava."

In the horse occasionally,‡ when the vena azygos enters (the right auricle) behind, there "is between it and the orifice of the anterior vena cava a muscular lamella, with a free concave border, which forms a kind of valve whose extent is very variable."

In the heart of the kangaroo, "which possesses many fea-

* Vulpian et Philipeaux. Sur les Viscera de l'Elephant, *Ann. des Sci. Naturell., par. Zoologie*, 1856, p. 198. I have given the above quotation *in extenso*, because it shows the valve was a more complex one than that described by Watson. They do not give the species of the elephant.

† Anatomy of Indian Elephant, *Jour. Anat. and Physiol.*, 1871, vol. vi., November, p. 87.

‡ George Fleming, in *Trans. Comp. Anat. of Domestic Animals*, Chauveau, p. 506.

tures in common with that of the bird," Owen says, "the wide terminal orifice of the posterior cava is separated from that of the right anterior cava by a simple crescentic ridge, which forms a salient angle of the parieties of the auricle between these apertures."

The echidna's heart possesses a membranous sickle-shaped fold guarding the left margin of the entrance of the right pre-cava.*

In birds, valves have not been hitherto observed at the right pre-caval orifice; in ophidia, the right auricle receives three large veins at its anterior part, and two at its sacral part, the former are guarded by valves.

So that, as regards position and attachments, this valve is analogous to those seen respectively in man by Dr. Handyside, in the Indian elephant by Dr. Watson, in the kangaroo by Professor Owen, and in the echidna, as I observed in a creature I lately dissected, and what occasionally occurs in the horse. The latter points out the true direction in which we must look for our homological relations, viz., to the valve of the 'vena azygos major,' especially in reference to those two cases described by Dr. Handyside.

Possibly some delay in the development of the right inferior cardinal vein (vena azygos major, adult), or some delay at the period when the junction between it and the superior vena cava (right primitive jugular vein and right duct of Cuvier) occurs, may account for those occurring in man.

Regarding the homologies of the valve described by Professor Turner, and of that found by Vulpian and Philipeaux in the elephant, I believe it to be a rudiment of the *lower* fold (anterior semilunar valve), placed at the entrance

* Care must be taken not to confuse this valve with the homologues of the folds separating 'sinus' from 'cavity of auricle proper,' as seen more especially in Great Ant-eater and Porcupine, again from the prominent upper rim of the 'fossa ovale,' so well seen in 'Trichecus.'

between the sinus venosus and cavity of auricle proper, in hearts of the serpent, crocodile, and emu (also in the apteryx).*

This view is further supported by the attachments of the eustachian valve, as seen in the hearts of the porcupine, the elephant, and great ant-eater, where remnants of both the upper and lower folds are present; and that the lower of these folds sometimes attains a remarkable size in man may be noticed by the cases described in *Proceedings Royal Society* (*loc. cit.*).

Prior to leaving these relics, that go to prove (as Dr. Watson so curiously quotes and *places*) "that man still bears in his bodily frame the indelible stamp of his lowly origin," I would just advert to the physiological interest of such a valve as that found in the heart of the emu, and which we have just described. It is quite obvious, from its relations and attachments, it must have exerted a considerable influence in directing the blood which entered the sinus towards the cavity of the right auricle, and away from the foramen ovale.

With reference to the valve found by Turner in man, I believe it would have exerted an action rather of guiding the blood towards the foramen ovale, than of directing the current away from the foramen; and I also suspect in that case we are to look upon it as of greater morphological interest than of physiological assistance to the economy.

As before mentioned, in general anatomical characters the heart agreed closely with Professor Owen's description; but there is one other point of interest, viz., the great coronary sinus joins the left pre-caval before the latter opens into the 'sinus venosus,' and the point where the left anterior cava

* 'The *right segment*' of the 'double muscular valve,' spoken of by Professor Turner, in the heart of the Struthio camelus is evidently identical with the *lower fold*. I would here just remark upon the discrepancies which occur as to connections of eustachian valve, in our text books.

opened was between the mouth of the post-cava and the posterior horn of the upper semilunar fold.

Betwixt the orifices of the post-cava and the left pre-cava, there is a well-marked membranous valve, which, long ago, had been recognised by Professor Owen as identical with the 'Thebesian valve' in man.

A similar valve is described as existing in the heart of the Southern apteryx (*Apteryx Australis*, Shaw).* It is also found in the heart of the crocodile, and in the kangaroo, where, in a majority of cases, the left pre-cava unites with post-cava; but even here the valve exists.† The specimen is preserved in the Free Public Museum, Liverpool.

* Owen, *Trans. Zool. Soc.*, vol. ii., p. 272.

† I have met with this valve in other birds' hearts, also a coronary valve, in several seals.

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